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DELETERIOUS MUTATIONS IN MAN
N. Freire-Maia

A RETURN TO THE PRINCIPLES OF NATURAL SELECTION
Frederick Osborn

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DELETERIOUS MUTATIONS IN MAN*

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THE MECHANISM of sexual reproduction and cross-fertilization creates the possibility for any population to accumulate a large number of recessive deleterious mutations. The incidence of these detrimental genetic variants in Mendelian populations will depend, however, upon a variety of factors among which are the population size, inbreeding coefficient, selection pressures, mutation rates, etc.

For practical purposes, deleterious genes may be roughly classified into two overlapping categories, namely, abnormals (visibles) and lethals plus semi-lethals. In man, direct (for the first category) and semi-direct and indirect methods (for both of them) have been employed in recent years to estimate the mean number of deleterious mutations carried by each person. It is the purpose of this paper to review and discuss the present status of our knowledge in this area.

*This work has been supported by grants from the National Research Council of Brazil, the Research Council of the University of Paraná and the Rockefeller Foundation.

INDIRECT PROCEDURE

The first approach to the problem, based mainly on *Drosophila* data extrapolated to man, leads to 8 as the number of "slightly dominant, detrimental mutant genes in heterozygous condition" (Muller, 1950). Some years late, based on the same indirect approach, Muller (1956) calculated at 6.5 the minimal figure "for the content of recessive, definitely detrimental mutations (including lethals), per individual human being."

DIRECT METHOD

The only direct analysis of the problem has been made by Stevenson (1959). Based on an extensive collection of data on the frequencies of genetically determined defects in Northern Ireland, Stevenson arrived at 0.52 recessives and 0.06 dominants per person. These estimates did not include sex-linked genes. Some 30 traits whose genetic mechanisms are not well known were also not taken into consideration. Even assuming that some of the latter may be due to one recessive gene mutation, "it is difficult to

account for more than one harmful mutant per person" (Stevenson, 1959).

SEMI-DIRECT APPROACHES

The first author to use a semi-direct approach, based on the data of consanguineous marriages obtained by Arner (1908), was Muller (1948). With a method whose details were not specified it was concluded that "every person on the average contains heterozygously at least one lethal gene or group of genes which (homozygously would) . . . kill an individual . . . between birth and maturity." The figure actually found was around 2.

A semi-direct method based on a suggestion by Reed (1954) was devised by Slatis (1954) and used to estimate the mean number of deleterious mutations in heterozygous condition in the ancestors common to the parents of the children under study. Slatis' data were highly biased in the direction of an increase in frequency of the genetic ailments, and he was aware of this distortion. Anyway, with his material, it was found "that the average person is heterozygous for eight abnormal genes."

Morton, Crow and Muller (1956) developed the concept of lethal equivalents and applied it to data from Bemiss (1858), Arner (1908), and Sutter and Tabah (1952). Lethal equivalents are defined as a group of deleterious genes in which a full lethal gene (with 100% penetrance) equals two semi-lethals with 50% penetrance, three semi-lethals with 33.3% penetrance, etc. Different causes of death, environmental or genetic, are assumed to be nonsynergistic. Using the French and American data, it was found that "the average person carries heterozygously the equivalent of 3-5 recessive lethals acting between late fetal and early adult stages" (mortality has been used from stillbirths up to the age of 20 years). The French data also suggested that "the average person carries about 4-5 genes which, if homozygous, could cause conspicuous abnormality." For lethals, Morton *et al.'s* method is based on the regression of the natural logarithm of the frequency of survivors on the coefficient of inbreeding. The regression coefficient so obtained (B) is the mean number of lethal equivalents per gamete (2B is the corresponding number per person). Schull (1958, 1959) verified that the regression coefficient obtained by fitting a weighted linear regression of the frequency of deaths on the inbreeding coefficients does not differ appreciably from the value of B estimated according to the laborious method of Morton *et al.* A new approach to the estimate of B has been suggested by Kimura (1958a, b). It has been called an "inverse approach" in the sense that the various degrees of inbreeding found in a sample of "affected" individuals are compared with those found in a sample of "normal" individuals. Regarding neonatal deaths, for instance, the method consists in comparing the distribution of the inbreeding coefficients detected in a sample of neonatal deaths with those found in a sample of normal births.

Böök (1957) and Penrose (1957) devised new methods which when applied to Böök's data from Sweden lead to "a minimum of three detrimental autosomal recessive genes in the heterozygous condition per individual" (Böök) and 2.94 "deleterious genes at different loci" (Penrose). Calculations by these authors included, however, only clear-cut abnormalities.

Slatis, Reis and Hoene (1958) developed the concept of abnormal equivalents (with the same genetic meaning as lethal equivalents) and defined detri-

mental equivalents as the sum of lethal equivalents plus abnormal equivalents. In the same paper, Slatis *et al.* introduced a correction to Penrose's method and made possible its use in mortality data when control information is available. With this correction, the number of abnormal genes per person in Böök's material is found to be 5.88 (twice the value of 2.94 found by Penrose). With data collected in the Chicago region, Slatis *et al.* arrived at 2.46 lethal equivalents and 2.03 abnormal equivalents, or 4.49 detrimental equivalents.

The expression "detrimental equivalents," introduced by Slatis, Reis and Hoene, in 1958, has been used by Chung, Robison and Morton (1959) to define a different concept. For these authors, the mean number of detrimental equivalents is the mean number of genes which, if made homozygous, would cause a specific detrimental trait. They applied this concept to deaf-mutism and concluded that, on the basis of data obtained by Stevenson and Cheeseman (1956) in Northern Ireland, "the average number of recessive genes for deaf-mutism per individual is 0.160 ± 0.024." In order to avoid ambiguities, the sum of lethal equivalents plus abnormal equivalents will be called deleterious equivalents in this paper.

A reanalysis of Böök's data by Slatis' (1954) method leads to 5.32 as the number of "detrimental mutant genes per person" (Slatis *et al.*, 1958). We applied the Penrose-Slatis method to Sutter's (1958) data and found, in the three French "départements" studied, 2-4 lethal equivalents (excluding abortions and miscarriages) and 2-5 abnormal equivalents, a total of 4-9 deleterious equivalents. The same method has been applied to Slatis' (1954) biased data, and 7 abnormals were found.

With data obtained in three Japanese cities and using a variant of Morton *et al.'s* method, Schull (1958) arrived at 0.17, 0.20 and 0.22 abnormal equivalents per person. He also found 0.74, 0.09 and 0.18 in "early deaths" (stillbirths plus mortality within the first month of life); 0.79 and 0.29 in deaths in 9 months; and 2.15 in data on deaths in 8 years. The total for one of the cities (Hiroshima) is 2.46 (data of malformations, stillbirths and deaths in 8 years); for the second (Kure) it is 0.29 (malformations plus early deaths); and for the third (Nagasaki) it is 0.47 (malformations, stillbirths and deaths in 9 months). The most complete information (where data on abortions, miscarriages, and mortality from 8 years up to the mean marriage age were lacking, however) suggests that the mean number of lethal equivalents carried by each person must be around 3 or even higher. The three series of data show that the mean number of abnormal equivalents (measured with data on "major congenital abnormalities") is around 0.20. If one makes allowance for the minor defects and for genetic diseases developing after birth, this number could rise to 1.0 or higher. Schull's data may be thus accepted as suggestive of values around 3 for lethal equivalents and around 1 for abnormal equivalents, with a total of deleterious equivalents of about 4.

Among 9,526 pregnancy terminations in recent times in Belfast, Stevenson, Dudgeon and McClure (1959) found 46 from consanguineous marriages. Using their data from first cousins, first cousins once removed and second cousins (the only ones whose degrees of relationship are given in their paper), one finds a mean number of lethal equivalents acting during the pregnancy equal to 4-5. Stevenson *et al.*'s data are biased in the

direction of an excess of inbreeding effect (see page 405 of the above-mentioned paper and page 387 of the first paper of the series). The value actually found (4.6) must be so accepted as an overestimate.

Zerbin-Rüdin (1960) investigated the offspring of 299 Roman Catholic consanguineous couples (287 first-cousin and 12 uncle-niece marriages) in the German Diocese of Münschen. As no control sample was obtained, comparisons have been made with available information for the Bavarian population. With a series of assumptions regarding the genetic nature of the anomalies found, and the part played by recessive genes in stillbirths and mortality from birth up to the age of 5, it was concluded that the number of abnormal recessive genes per person equals 3.19 and that of lethals equals 2.15. As Zerbin-Rüdin used Penrose's (1957) formula, these figures must be doubled; so the values are 6.38 and 4.30, giving a total of 10.68. These figures must be accepted, however, with great caution due to the number of assumptions involved in their calculations.

In a recent paper, Morton (1960) estimated the values of B from the abnormality data in the French, Swedish and American material already referred to. These data revealed about 3 abnormal equivalents per individual.

A series of data suggest that the number of lethal equivalents with action during the embryonic and fetal periods is very low when compared with those acting in childhood and adulthood (see Schull, 1959). These data do not cover, however, the whole pre-natal period, as no information is available for the early stages of pregnancy. The possible action of deleterious genes on these early stages has not been investigated as yet. To this problem we shall return shortly.

A formula to be used in samples of marriages with different degrees of consanguinity has been developed by Freire-Maia and Freire-Maia (1960) and applied to data from Brazilian rural populations (Freire-Maia, Freire-Maia, and Quelce-Salgado, 1960). Among Caucasians, the estimate of the mean number of lethal equivalents per person lead to a negative value (—0.37). When only marriages whose offspring had the highest coefficients of inbreeding (from 1/16 up to and including 1/8) were used, this value turned out to be 0.06. For marriages with $f = 1/16$, the figure was 0.10. Among Negroes, however, the corresponding value was found to be 9.12. Values of 1.20, 1.89, and 12.15 were found through the analysis of the offspring of Caucasians $\times$ Non-Caucasians (Mulattoes plus Negroes), Mulattoes $\times$ Mulattoes, and Mulattoes $\times$ Negroes.

Morton, Crow and Muller's approach was also applied to the Caucasian and Negro data obtained in Brazil (Table 1). The values of A (the intercept characterizing the mortality within the control group) are rather similar in both ethnic classes in each category (cf. also the control data in Freire-Maia *et al.*, 1960). This suggests that the two ethnic groups are living under similar environmental conditions. The values of B (which is the regression coefficient of the natural logarithm of the frequency of survivors on the coefficients of inbreeding and expresses the genetic load per gamete) are much higher among Negroes than among Caucasians, however. The estimates of the mean number of lethal equivalents per individual (i.e., 2B) are close enough to those obtained according to our method: a negative value for Caucasians (suggestive of a very low actual value of 2B; see also Table 2) and a value for Negroes

TABLE 1

VALUES OF A, B, B/A AND 2B OBTAINED BY THE METHOD OF MORTON, CROW AND MULLER (1956) IN BRAZILIAN RURAL POPULATIONS.

Ethnic Groups	Abortions Plus Miscarriages			Stillbirths			Mortality After Birth			Total			
	A	B	B/A	A	B	B/A	A	B	B/A	A	B	B/A	2B
Caucasian	0.11	-0.23 ± 0.28	—2.09	0.04	0.15 ± 0.20	3.75	0.21	-0.01 ± 0.45	—0.05	0.36	-0.09 ± 0.57	—0.30	—0.18
Negro	0.09	3.06 ± 1.39	34.00	0.04	0.80 ± 0.85	20.00	0.23	0.51 ± 1.29	2.22	0.40	4.37 ± 2.06	13.08	8.74

TABLE 2

VALUES OF A, B, B/A AND 2B OBTAINED ACCORDING TO THE VARIANT OF SCHULL (1958) TO THE METHOD OF MORTON ET AL.— (1956)

ETHNIC GROUP	Abortions Plus Miscarriages			Stillbirths			Mortality After Birth			TOTAL			
	A	B	B/A	A	B	B/A	A	B	B/A	A	B	B/A	2B
White x White	0.11	—0.16	—1.45	0.04	0.21	5.25	0.19	0.03	0.16	0.34	0.08	0.24	0.16
White x Non-White	0.11	—0.58	—5.27	0.04	0.62	15.50	0.19	0.70	3.68	0.34	0.74	2.18	1.48
Mulatto x Mulatto	0.10	0.37	3.70	0.04	0.23	5.75	0.19	1.03	5.42	0.33	1.63	4.94	3.26
Mulatto x Negro	0.07	2.19	31.29	0.05	—0.58	—11.60	0.17	4.06	23.88	0.29	5.67	19.55	11.34
Negro x Negro	0.09	2.80	31.11	0.04	0.83	20.75	0.21	0.43	2.05	0.34	4.06	11.94	8.12
Total	0.10	0.20	2.00	0.04	0.26	6.50	0.19	0.55	2.89	0.33	1.01	3.06	2.02

between 8 and 9. The difference between the values actually found for B (−0.0929 and 4.3658) is significant at the 5% level ($t = 2.11$). Regarding the three components of the total value of B, a significant difference was only found for abortions plus miscarriages (t=2.32; $p = 0.02$). For stillbirth, $t = 0.73$ and for post-natal mortality, $t = 0.40$). For the ratio B/A, see the Discussion.

The less laborious procedure suggested by Schull (1959) was also applied to our Brazilian data (Table 2). These estimates of B also increase from Whites to Negroes. Assuming for the ethnic classes the arbitrary values ascribed to them by Freire-Maia *et al.* (1960), a positive correlation was also found ($r = 0.87^{*}$).

Based on these three series of calculations, the mean number of lethal equivalents may be less than 1 for our Brazilian Caucasian sample and around 9 for the Negroes. As pointed out in the original paper, these results refer exclusively to the populations where the investigation was carried out. No generalization can be made uncritically.

Simões, Marçallo and Freire-Maia (unpublished) estimated the mean numbers of lethal and abnormal equivalents as 2-3 each, among 114 Roman Catholic families (43 being consanguineous) in Curitiba, South Brazil (4-6 deleterious equivalents). These families generally range from the middle to the high social level. The data (which include abortions, miscarriages, stillbirths, deaths from birth up to the mean marriage age, and anomalies in general) were collected by home visitations to consanguineous couples whose addresses were obtained through the cooperation of the ecclesiastical authorities. Families closely related to the consanguineous ones were used as controls. This is preliminary information on continuing research.

DISCUSSION

The classification of deleterious equivalents into lethal and abnormal equivalents is clearly artificial. They do not form clear-cut, non-overlapping categories, as each class possesses a component of the other. This criterion of classification is also somewhat unrealistic when one attempts to use it as a measure of the load of mutations carried by man, since all lethals as well as abnormals do not produce the same kind of individual and social burden to humanity. Lethals and semi-lethals acting during the first few days of pregnancy cause no pain or distress, while those acting on the first years of life may represent a tremendous source of suffering and disgrace. Also, abnormals causing small deviations from normality cannot be compared with such genes as those producing highly mutilating anomalies such as achiropody, or severe mental disorders such as schizophrenia. But even the same gene may produce different impacts, the amount of personal and social damage caused by it being also a function of the social group where it operates. For an analysis of this problem, see Wright (1960), Crowe, Schull and Neel (1956), Freire-Maia, Quelce-Salgado and Koehler (1959) and Freire-Maia (1960).

The mean number of deleterious equivalents per individual, as shown by the majority of the data here reviewed, lies between 4 and 12 (lethals and abnormals between 2 and 6 each). In these data, the number 8 (for deleterious) and 4 (for lethals and abnormals each) may be accepted as representing orders of magnitude.

Human groups may differ in the mean number of deleterious mutations per in-

dividual, as a consequence of different intensities of evolutionary pressures and differences with respect to the other parameters which define population structure, such as the inbreeding coefficient and the rate of assortative mating. Thus, estimates obtained in different populations need not be always in close agreement. As a matter of fact, a few exceptions to the above more common values have been found in Northern Ireland, Japan and Brazil. However, perhaps not all of these really reflect the actual situation. The discrepancy between the rather low (less than 1) value Stevenson obtained for abnormals as estimated on the basis of a direct approach, and those (from 2 to 6) which form the majority and have been obtained by semi-direct methods, may be due either to the fact that not all the genetic abnormalies have been put on record in Stevenson's list, and/or that Stevenson's estimate refers to strict abnormals, not to abnormal equivalents. The exceedingly low value for abnormal equivalents (around 0.20) found by Schull in Japan is certainly due to the criterion of only computing major congenital malformations and must be accepted as only indicating an estimate of the number of equivalents for this strict class of gross abnormalities. If allowance is made for the minor congenital malformations as well as for the genetically determined and conditioned anomalies developing after birth, this estimate would be much higher, as already pointed out. We do not know, however, how high this estimate might reach.

Brazilian data are particularly impressive because they refer to two ethnic groups living practically under the same physical and social conditions and show Negroes with a number of lethal equivalents per individual significantly higher than Caucasians. It is rather difficult to envisage all of the factors which might make for so large a difference. No evidence of a higher mutation rate or a higher incidence of abnormalities among Negroes is known as yet (cf. Neel, 1958). Regarding natural selection, it is apparent, at least historically, that its action was stronger among Negroes than among Caucasians. Nevertheless, inbreeding seems to be (see data in Table 1 of Freire-Maia, *et al.*, 1960), and to have been, higher among Caucasians. A rigid approach to this difference seems premature, however, in view of the paucity of the data. Clearly, further observations are to be desired.

It is well known that the mechanism of inbreeding is not equally important in all genetic situations. The inbreeding effect increases, for instance, linearly with an increasing coefficient of inbreeding in cases of monogenic traits, but the situation is much more complicated when one deals with polygenic traits or with monogenic traits capable of polygenic suppression. Moreover, inbreeding will decrease the incidence of traits due to mother-fetus incompatibility such as that regarding Rh. In a review of these problems, Levins (1959) points out that suppression of inbreeding effect (and non-linearity) would be expected much more in old isolated populations than in populations of recent origin. A population which practiced inbreeding for a large number of generations may have developed a system of polygenic modifiers which would decrease the phenotypic manifestation of harmful genes, and thus partially remove them from the action of natural selection. The frequency of these harmful genes would increase, but the incidence of their respective phenotypes would be maintained at the same level. As geneticists work with pheno-

types to evaluate genotypes, this situation could not be readily distinguished from one where the same inbreeding effect was prevailing without the operation of polygenic modifiers.

Our Brazilian populations are not ideal ones for comparisons of this type. It is true that the Caucasian group we studied in the central state of Minas Gerais is not so heterogeneous as those found in the South, where large numbers of immigrants with quite different origins are to be found; whereas the Caucasians from Minas Gerais are almost exclusively composed of descendants from the Portuguese. It is known, however, that the present-day Caucasian populations of Minas Gerais stem from the admixture of people coming from different Portuguese isolates. The latter were undoubtedly as inbred as any other European isolate of the same period. With respect to the Negroes, the same holds for the break-up of isolates, since slaves from different tribes were brought to Brazil. It is widely known, however, that these Negro populations were characterized in their native land by social systems which tended to prevent inbreeding. Thus, Portuguese populations may have developed efficient systems of polygenic suppression of the effect of harmful recessive genes whereas Negro populations may not have. If this is true, the values of B detected in our Negro and Caucasian samples would not represent strictly comparable numbers of lethal and semi-lethal genes per gamete. The actual numbers could be the same in both samples or even higher among Caucasians, the low number of lethal equivalents among Caucasians being but the effect of a large number of modifiers. The linear correlation between the number of lethal equivalents and the ethnic composition of the couples suggests that Negroes and Caucasians do really differ in regard to the incidence of lethal and semi-lethal genes. The linearity between inbreeding effect and values of f also supports this hypothesis. As a matter of fact, this kind of linearity is widely known in the experiments dealing with inbreeding depression (cf. Falconer, 1960).

A procedure to evaluate the relative contributions of the *mutational load* (due to the action of non-heterotic recessive deleterious genes maintained by recurrent mutation) and the *segregational load* (due to harmful recessive genes in equilibrium by the mechanism of balanced polymorphism) to the *genetic load* of a population has been devised by Crow (1958). He has shown that the ratio of the inbred load to the randomly mating load is $1/2h$ for non-heterotic alleles with a rate h of dominance. As h in man may be roughly accepted as 0.025 (unpublished results of Hiraizumi; see Crow, 1958), the number of deaths in a completely inbred population would be 20 times larger than in a panmictic population. For overdominant genes in a system of superior heterozygotes, however, the segregational load equals $st/(s+t)$ in a random mating population (i.e., the genetic damage this population would suffer compared to an ideal population composed entirely of heterozygotes) and $2st/(s+t)$, i.e., two times higher, in a completely inbred population. The ratio of the genetic load in an inbred population to that in a panmictic one could be obtained by dividing B by a value which one knows to be smaller than A since A includes a certain number of deaths due to non-genetic factors. As this value is not known, A may be used as a rough approximation in populations with high standards of living, where abortions, miscarriages, stillbirths and mortality dur-

ing childhood and early adulthood have relatively low incidence and may be largely due to genetic factors. In the rural zones we studied in Brazil, however, these events are primarily due to the poor conditions of living (hard work and no medical assistance during pregnancy, deficient food and clothing, high incidence of diarrhea and tetanus in early childhood, etc.). The ratio B/A may be highly misleading in such rural populations due to the enormous error introduced in A, which is much larger than the genetic damage in a random mating population. When B is very small (as in the Caucasian sample we investigated), B/A will take rather small values and these values cannot be used for inferences regarding the contribution of the mutational load and of the segregational load to the general genetic load of the population. The ratio to be used in Crow's model is actually larger, but we do not know how large it is. When B is large (as in our Negro sample), however, B/A will take relatively high values and, as we know that A possesses a certain proportion of non-genetic deaths, the actual ratio will be still larger.

In several comparisons made with data obtained in French, American, and Japanese populations (cf. Morton *et al.*, 1957; Schull, 1958, 1959; Morton, 1960), the ratio B/A leads to values close to the expected ones in the model which emphasizes the over-all importance of the mutational load. (See also the paper by Kimura, 1960.) In our Negro data (Tables 1 and 2), that ratio is also large enough regarding abortions plus miscarriages, stillbirths and total to permit the conclusion that the genetic load is mainly of the mutational-load type—i.e., due to harmful genes which are being maintained in the population by recurrent mutation. All these considerations must be accepted, however, with some caution, as they have been obtained by the use of models which may not correspond strictly to reality.

A fourth aspect of the data deserves some attention. As previously stated, information obtained in some populations suggests that the number of lethals acting before birth (or, to be more exact, from about the second month of pregnancy until birth) is much smaller than that with post-natal action. This fact shows that the human embryo is so well protected during that period, in those populations, that deleterious genes hardly impair its possibilities of survival. As Schull (1959) pointed out, "at a time in life when survival is as intimately associated with the mother as is true of a developing fetus, survival of the fetus may be as much, if not more, a function of maternal genotype than of the fetal genotype." A few data obtained by Schull in Japan are in agreement with this possibility. It is well known that, in mammals, the inbreeding depression observed in a given generation is due not only to the inbreeding of the individuals measured but also to the inbreeding of their mothers (see Falconer, 1960). The deleterious effect on the offspring of homozygosity for a gene which is harmless to the mother has been discovered by Hammond (1934) in rabbits, and a similar situation could exist in man, as suggested by Penrose (1940). A few cases (including mongolism, whose etiology was unknown at that time) recorded by Penrose did not contradict this possibility. The data collected up to now on man (Penrose, 1940; Schull, 1959), which bear directly on this problem, are too scanty to permit reliable conclusions on this matter; however, the large body of data on consanguineous marriages from the three different coun-

tries mentioned above suggests that recessive mutations do not contribute greatly to pre-natal mortality. In the total Brazilian data (Table 2), the number of lethal equivalents producing embryonic and fetal deaths (0.92) seems to be not much smaller than that responsible for mortality in childhood and early adulthood (1.10). It is our impression that this may be due to the rather poor health conditions prevailing in the rural Brazilian region investigated, in comparison with the populations previously investigated.

The low economic level of the families we have studied, together with the poor hygienic conditions in which they live and the reduced medical assistance they have, decreases enormously the natural protection of the embryo. Deficient nutrition, excess of work, and untreated diseases during pregnancy could create conditions favoring the manifestation during embryonic and fetal life of sub-normal genes which would probably pass unnoticed in populations with high standards of living. It is convenient to point out, a second time, that human data on abortions never include those occurring in the first weeks of pregnancy. So, all the conclusions reached in this matter refer only to abortions occurring after the second month of gestation. Inbreeding effect may be strong in regard to early embryonic deaths and yet pass unnoticed on the basis of the data generally found in the literature. Any conclusion with such incomplete data seems to be rather premature.

It is a well-known fact that the phenotypic effect of a gene depends not only on the genetic environment, where a constellation of modifiers may have an over-all importance, but also on the external milieu. In man, it is quite probable that modern civilization is increasing the frequencies of a number of deleterious genes by removing them from the action of natural selection. It seems that many detrimentals are having their frequencies increased in populations such as those investigated in Sweden, Japan, and United States, while such a process is not going on in the rural Central Brazilian populations of Minas Gerais we studied. These Brazilian populations may have, however, a large store of mutations which are slightly detrimental within their living conditions and which may prove highly deleterious—in a process of decreasing frequencies—when subjected to the socio-economic environment of modern life. These considerations lead one to conclude that human populations living under "primitive" and "modern" conditions will develop different loads of mutations even with the same raw material. The *total mutational damage* (in the sense used by Morton, Crow, and Muller, 1956) found in various populations may be an expression of the differing action of natural selection on these various groups in the past.

SUMMARY

A review is made of the several (indirect, semi-direct, and direct) methods used for estimating the mean number of deleterious mutations per person. The results so obtained are presented. These findings are discussed in connection with some of their implications regarding the genetic structure and the standard of living of populations.

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BIBLIOGRAPHY

ARNER, 1908. *Columbia Univ. St. in Hist., Ec., and Publ. Law*, **31**, No. 3: 1-99.

BEMISS, 1858. Report on influence of marriages of consanguinity upon offspring. *Trans. Am. Med. Assn.*, **11**: 319-425.

BÖÖK, J. A., 1957. Genetical investigation in a north-Swedish population. The offspring of first-cousin marriages. *Ann. Human Gen.*, **21**: 191-223.

CHUNG, C. S., O. W. ROBISON and N. E. MORTON, 1959. A note on deaf mutism. *Ann. Human Gen.*, **23**: 357-366.

CROW, J. F., 1958. Some possibilities for measuring selection intensities in man. *Human Biology*, **30**: 1-13.

CROWE, F. W., W. J. SCHULL and J. V. NEEL, 1956. *A Clinical, Pathological and Genetic Study of Multiple Neurofibromatosis.* Chas. C. Thomas, Springfield, Ill., 182 p.

FALCONER, D. S., 1960. *Introduction to Quantitative Genetics.* Ronald Press Co., New York, 366 pages.

FREIRE-MAIA, N., 1960. Da adaptação e da seleção natural. *Anhembi*, No. 113: 236-261.

FREIRE-MAIA, N. and A. FREIRE-MAIA, 1960. An estimate of the human load of mutations from heterogeneous consanguineous samples. *Science* (in press).

FREIRE-MAIA, N., A. FREIRE-MAIA, and A. QUELCE-SALGADO, 1960. Lethal mutations in Brazilian human populations. *Nature* (in press).

FREIRE-MAIA, N., A. QUELCE-SALGADO, and R. A. KOEHLER. 1959. Hereditary bone aplasias and hypoplasias of the upper extremities. *Acta genetica*, **9**: 33-40.

HAMMOND, J., 1934. *Apud* Penrose, 1940.

KIMURA, M., 1958a. Inverse approach to the estimation of genetic load disclosed by inbreeding. *Annual Rep. Nat. Inst. Gen.* (Japan), No. **9**, pp. 88-90.

KIMURA, M., 1958b. Theoretical basis for the study of inbreeding in man. *Jap. J. Human Gen.*, **3**: 51-70.

KIMURA, M., 1960. Relative applicability of the classical and the balance hypotheses to man. Especially with respect to quantitative characters (in press).

LEVINS, R., 1959. Discussion. *Eug. Quart.*, **6**: 109-111.

MORTON, N. E., 1960. The mutational load due to detrimental genes in man. *Am. J. Human Gen.*, **12**: 348-364.

MORTON, N. E., J. F. CROW, and H. J. MULLER, 1956. An estimate of the mutational damage in man from data on consanguineous marriages. *Proc. Nat. Acad. Sc. USA*, **42**: 855-863.

MULLER, H. J., 1948. Mutational prophylaxis. *Bull. New York Acad. Med.*, **24**: 447-469.

MULLER, H. J., 1950. Our load of mutations. *Am. J. Human Gen.*, **2**: 111-176.

MULLER, H. J., 1956. How radiations change the genetic constitution. "Progress in Nuclear Energy," series six. *Biological Sciences*, vol. 1, pages 14-34.

NEEL, J. V. 1958. A study of major congenital defects in Japanese infants. *Am. J. Human Gen.*, **10**: 398-445.

PENROSE, L., 1940. The grandchildren of consanguineous unions. *Trans. Royal Soc. Canada*, sect. V, 93-97.

PENROSE, L. 1957. A note on the prevalence of genes for deleterious recessive traits in man. *Ann. Human Gen.*, **21**: 222-223.

REED, S. C., 1954. A test for heterozygous deleterious recessives. *Journ. Hered.*, **45**: 17-18.

SCHULL, W. J., 1958. Empirical risks in consanguineous marriages: sex ratio, malformations, and viability. *Am. J. Human Gen.*, **10**: 294-343.

SCHULL, W. J., 1959. Inbreeding effects on man. *Eug. Quart.*, **6**: 102-109.

SLATIS, H. M., 1954. A method of estimating the frequency of abnormal autosomal recessive genes in man. *Am. J. Human Gen.*, **6**: 412-418.

SLATIS, H. M., R. H. REIS, and R. E. HOENE, 1958. Consanguineous marriages in the Chicago region. *Am. J. Human Gen.*, **10**: 446-464.

STEVENSON, A. C., 1959. The load of hereditary defects in human populations. *Radiat. Research*, suppl. 1, 306-325.

STEVENSON, A. C., and E. A. CHEESEMAN, 1956. Hereditary deaf mutism, with particular reference to Northern Ireland. *Ann. Human Gen.*, **20**: 177-231.

STEVENSON, A. C., M. Y. DUDGEON, and H. I. MCCLURE, 1959. Observations on the results of pregnancies in women resident in Belfast. II. Abortions, hydatidiform moles and ectopic pregnancies. *Ann. Human Gen.*, **23**: 395-414.

SUTTER, J., 1958. Recherches sur les effets de la consanguinité chez l'homme. *La Biol. Médicale*, **47**: 563-660.

SUTTER, J., and L. TABAH, 1952. Effects de la consanguinité et de l'endogamie. *Population*, **7**: 249-266.

WRIGHT, S., 1960. On the appraisal of genetic effects of radiation in man: *The Biological Effects of Atomic Radiation* (summary reports, Nat. Acad. Sc. Nat. Res. Counc., Washington), pp. 18-24.

ZERBIN-RÜDIN, EDITH. 1960. Über den Gesundheitszustand von Kindern aus nahen Blutsverwandtenehen. *Z. menschl. Vererb.-u.-Konst.*, **35**: 233-302.

A RETURN TO THE PRINCIPLES OF NATURAL SELECTION

FREDERICK OSBORN

Editor's Note: It is generally agreed that much further research is needed if eugenics is to make progress. But it is difficult to agree on what types of research are needed so long as there is no theoretical framework covering the operation of eugenic selection and so long as we are without objective criteria for measuring the types of people being selected. The following article is of immediate interest because it proposes answers to these questions. The Quarterly would like comments from its readers on the practical soundness of these proposals compared with other suggestions.

THE AIM OF EUGENICS should be to restore the principles—but not all the methods—of natural selection as it operated for 500,000 years of prehuman and human evolution.

NATURAL SELECTION—SELECTION FOR AN ENVIRONMENT

During the long period of prehistory the measure of selection was ability to cope successfully with the environment. Selection was related directly to achievement, namely, to survival. The area of selection included both the physical and the social environments. When prehuman primates first began to use tools, the area of physical selection was progressively reduced and that of social selection increased. The first tools may have been only small stones in their natural shapes, but they gave their users a new weapon in their struggle for survival. It took intelligence to use tools, even stones. When natural selection began to favor those who among other things used tools most effectively, intelligence became the critical factor in the selective process. Intelligence could invent new tools, develop new uses for them, and so increase its selection advantage. At the same time, prehuman man began to develop responsible social relationships based on kinship. Success in the social group, the care of others, became a factor in survival. "The structure of modern man must be the result of the change in the terms of natural selection that came with the tool using way of life.—The reason that the human brain makes the human way of life possible is that it is the result of that way of life."[1]

THE DECLINE OF NATURAL SELECTION

The conditions in which natural selection operated were altered when man gave up hunting and gathering in favor

[1]Sherwood L. Washburn. Tools and Human Evolution, *Scientific American*, Sept. 1960.

of agriculture and the domestication of animals. Since food was distributed among large groups of people, individual abilities did not count so much toward survival in times of drought and famine. At the same time, during long periods when food was relatively abundant, ties of kinship made people care for the weak and inefficient. Selection was becoming less related to achievement. With the coming of civilization the relation between selection and achievement declined and probably continued to decline during the 6,000 years of recorded history.

The real breakdown in the relation of natural selection to achievement, or "success," in an environment has come in the last hundred years. Until the middle of the nineteenth century, almost half of all infants born died before they reached the age of reproduction. Selection by deaths still had a chance to operate. At the same time married women were having children about up to the biologic maximum, and there could have been little selection by births except for biological fitness. Then two things happened almost simultaneously in the more technically advanced countries. The death rate began going down, and the introduction of birth control began slowly to reduce the birth rate. The reduction in deaths caused an immediate increase in the growth of populations. The first result of the reduction in births was greatly to increase differential fertility between social, economic and educational groups. The use of birth control began among the more educated people and was rapidly extended among them. It spread much more slowly among the less educated. At the period of extreme differences, which in the United States came during the great depression, large groups of the more educated couples were having only half the birth rate of the less educated. If we assume, as we have some ground for doing, that the more educated couples had on the average a superiority, however slight, in the genetic capacity for developing intelligence, then, as between these groups and for this period of time, natural selection had gone into reverse.

This situation was in part temporary. The great post-war baby boom was largely a phenomenon of the white-collar classes. Their birth rate almost doubled between 1940 and 1960 and accounted for most of the rise in births in that period.[2] The proportion of families of five or more children continued its long decline. Group differentials lost much of their significance. Within the major groups in our society we do not know what kind of people are having the most children or in what direction we are moving. There is evidence for genetic gains but also for genetic losses.

Meantime deaths have continued their rapid decline. In the United States today, over 95% of all children born alive live to reach their thirtieth year, which is the middle of their reproductive period. At such a low death rate, the chief selective effect of death is to keep down those genetic anomalies which result in early deaths. Selection for traits of personality and intelligence can no longer operate through selective deaths.

Thus there is no evidence now available which indicates that on balance, man's genetic structure is changing in a direction which will make him more able to cope with his increasingly complex environment. It seems that natural se-

[2]Calculated from Graybill, W. H., Kim, C. V., Whelpton, P. K., "Fertility of American Women," Wiley & Son, 1958. Tables 48-54. Cum. Series P20, No. 84, Table 5.

lection for man's higher traits has for all practical purposes ceased to operate. The most important long-term job facing man today is to get natural selection back to selection for success or achievement in the human environment.

A RETURN TO NATURAL SELECTION

In the past, natural selection operated mainly through deaths. Obviously we are not going to return to that method if we can help it. Our alternative is to enlarge the part played by birth selection. Voluntary birth control gives us a special opportunity to switch from death selection to birth selection.

It seems pretty certain that present methods of birth control, which are difficult to use and not always effective, will soon be superseded by physiological means of control which will prevent conception over considerable periods of time by means of a pill, a vaccine, or an immunization. The prospect of such a development is sufficiently good to justify our considering birth selection in terms of conditions of entirely voluntary parenthood, when parents will have children only after passing a deliberate judgment that they want them. We can get some idea of the effect of such a development by analysis of studies of couples using present methods of birth control.

Recent studies have been made on large-scale samples of the U.S. population, in which the couples using contraception most effectively have been studied separately from the others. For such couples there are indications of a trend toward size of family being related directly to income, that is, couples with incomes of six thousand dollars may, under certain conditions, be having more children than couples with incomes of five thousand dollars, and so on.[3] Indications of a similar trend have appeared in a number of studies in this country and abroad. Thus, under conditions in which birth control is used and is effective, pressures of an economic sort have a direct effect on the distribution of births. It seems probable that if, with new methods of fertility control, parenthood became even more a matter of personal decision, similar tendencies would provide opportunities for the development of a whole set of pressures not only economic but also social and psychological, which would tend to a selection of births favorable to genetic improvement. "The response would be voluntary, a selection drawn out by the environment itself, so that, in so far as children tend to resemble their parents for either hereditary or environmental reasons, there would be in each generation a proportionate increase in the number of people best fittted to the environment."[4]

It is not likely that voluntary parenthood alone would be sufficient to produce a population best fitted to succeed in its social environment. But so long as birth control offers some tendency along selective lines, it should be easier to develop measures which would strengthen and confirm the tendency. Such measures should be developed from the knowledge obtained in studies of factors affecting family size among people of different kinds and different environments. This is a proper field for sociological study. To be carried out effectively, we require criteria for those qualities which are to be selected for survival.

[3]Freedman, R., Campbell, A. A., Whelpton, P. K., "Family Planning, Sterility and Population Growth," McGraw-Hill, 1959, p. 293.

[4]Osborn, Frederick, "Preface to Eugenics." 2nd ed. Harper's, 1951, p. 240.

CRITERIA FOR NATURAL SELECTION

The criteria must be of a sort which will define fitness in terms of success in the various social environments men live in today. For this we know nothing better than to accept the forms of recognition given by society itself. Every society offers its members rewards for the work they do. In our society the rewards vary in kind, including wages paid and prestige elements, such as Federal judgeships and inclusion in "Who's Who," a higher education, and many other evidences of achievement. But for the great majority of people the rewards are mostly in money, and this criterion will be necessary in measuring the larger groups. Money rewards can be scaled, which is an advantage to the investigator. The recognitions given by society provide a generally accepted value judgment of the individual's achievement of "success" in his environment. If the judgments are "wrong" the fault lies with society, and we should try to change the society.

It will be immediately argued that even in the best society many rewards go to the wrong people for the wrong services. But so was the reward of death in many instances in the past. All we can hope for is to find measures which most nearly, and for the greatest number of instances, define qualities valuable to society. The measures now proposed are probably more accurate in more instances than were the measures used in the old processes of natural selection where pure chance played so large a part. Considerable elasticity is permissible in using the rewards given by society as a measure of value. We do not include rewards to those whose work is clearly anti-social, or those who have taken rewards in defiance of the law, as gamblers, racketeers, etc. Nor need we be too concerned that we are eliminating from procreation some valuable elements now not recognized by society. No man-made alterations in natural selection are going to work so well that man will thenceforth breed to a particular type or types and none other. All we can hope for, and indeed all that is desired, is that by and large, in general, man's genetic structure will be changing in the direction of making him more able to cope with his environment. Since man must operate in a great number and variety of environments, he would by natural selection be breeding not to one type but to as many different types as there are different environments and different types of human activities.

The proposed criteria would provide tools for measurement which do not involve value judgments on the part of those who are studying and making proposals. The factors to be studied would range from existing social institutions as they affect birth rates, to psychological pressures which may affect parental decisions. Most of the institutions needing study are already under pressure for change by people who want to improve social conditions.

A few of such situations may be listed as examples.

SOCIAL SANCTIONS AFFECTING THE DISTRIBUTION OF BIRTHS

Tax Structures. There have been a number of studies recently on the attitudes of parents in regard to desired size of family. These all tend to confirm the impression that in the great middle-income group of families which includes the professional classes, the cost of rearing children and particularly the cost of higher education is a limiting factor in decisions as to size of family. Present income-tax load is particularly high for the parents of children in this group.

Deductions for children have been made larger in recent years but are not nearly large enough to offset the cost of a college education. Most professional people spend an unusually long time in preparation before they begin to have earning power, and they marry late. But they cannot regain the lost ground. After paying their income tax, there is no sufficient margin for the later education of their children. These people are among the most useful and most needed in our society, and it has long been felt that changes should be made in the income-tax laws for their benefit as a matter of social justice and to encourage more people to enter these fields. An equally important reason for such changes is the effect of the present law on the distribution of births. Tax laws which put a disproportionate burden on couples in the middle-income groups when they have children tend toward an inverse relation between selection and achievement.

Illegitimacy. There are about 200,000 illegitimate children born in the United States each year.[5] Few people would affirm that bearing illegitimate children is in itself a mark of "fitness" in our society. Yet, apart from a diminishing social disapproval, society does little to discourage such parents in their ill-considered propagation. Society makes varying degrees of effort to care for the children, and this is right and proper. But these efforts should not relieve the parents of their responsibility, as is now too often the case. Our laws should be greatly strengthened, to seek out the father and require that he bear part of the expense and to hold the mother to her responsibilities to the child. Such changes are widely urged on the grounds that society needs them for its protection. Changes are also desirable for their effect on the distribution of births. A high frequency of illegitimacy is also a force tending to an inverse relationship between selection and an effective response to the environment.

Marriage Laws and Divorce. It is quite generally agreed that our marriage laws should be drawn to prevent, so far as possible, the marriage of people who are not prepared for the responsibilities of having children. Most states do not permit marriages at ages considered too young to undertake the responsibility of rearing children. But the state laws are not uniform in this matter. Few states proscribe marriage by individuals who are too feeble minded to give their children adequate care, or by alcoholics, and others whose children will in turn become social problems. In most states divorce laws do not sufficiently hold parents seeking divorce to their responsibility to their children. Because state divorce laws are not uniform and requirements for residence easy or easily evaded, most people think that divorce will be easy. But easy divorce tends to encourage careless marriage, and marriage, careless or not, promotes childbearing. Marriage and divorce laws should be drawn with more consideration for their effect on the distribution of births.

There are many other economic and legal conditions which could be changed to the immediate benefit of society, and such changes would at the same time bring us closer to the principles of natural selection for achievement.

Further studies may be expected to develop valuable information in the field of psychological pressures which af-

[5] U. S. Dept. of Health, Education & Welfare, National Office of Vital Statistics, Vital Statistics of U.S. 1958, "General Characteristics of Live Births," Sect. 12, Table 38, p. 264, 1960.

fect couples in their decisions as to size of family. It is already known that couples are influenced by the opinions and attitudes of those in their immediate surroundings. They want to follow the fashion in regard to size of family, and the fashion is usually quite undiscriminating. During the depression, in the white-collar groups, strong social pressures were exerted to maintain the "fashion" of small families. Just now, in the same groups, the "fashion" is for large families. It should be possible to develop a fashion which is discriminating and encourages children among people who are making a recognized contribution to society and who could be counted on to give their children responsible care, while it discourages children among couples less suited to parenthood. Psychological pressures of this sort are becoming increasingly important with the increasing spread and effectiveness of means of fertility control.

HOW FAST MIGHT CHANGE BE EFFECTED?

Such proposals as those which we have indicated, and those we believe can be developed through further study, would change present trends. We would be coming back toward the principles of natural selection for an environment by which man became continually better fitted to handle an increasingly complex environment. It is time that this system of continuing genetic change be re-established. We seem to have developed a society so complex that it is beyond the ability of any but the most highly endowed of our people to handle it. We are only fooling ourselves if we think that we can sufficiently increase, by educational means alone, from the ranks of the less well endowed, the proportion of really able people we presently need.

Our hope lies in the fact that we do not have to wait for nature to develop a new and different type of man. We have only to increase the proportion we now have of people whose genetic endowment fits them to achieve the highest development. Scientific opinions differ as to how rapidly this could be done. Geneticists do not know how many genes are involved in the development of man's mental and emotional machinery. They do not know the method of their interaction, nor in which chromosomes they are located. Nor is it known whether the genes are separately and widely distributed throughout the population or are considerably concentrated in particular family lines. Lacking such knowledge, while geneticists do not reject proposals of the sort being considered, they cannot at present endorse them. There are, of course, exceptions. H. J. Muller, Nobel prize winner in genetics, supports such proposals and goes considerably further. He urges insemination with sperm from people generally recognized as having made important contributions to society. He suggests that the sperm might be frozen and used after the death of the donor so as to avoid the psychological difficulties arising when the donor is alive at the time of insemination. He would be using the soundest criteria of a person's value, namely, the judgment of society after death. It thus embodies to the highest degree the criteria of selection for achievement in an environment. But it is opposed to our present mores and may take some time for acceptance.

Paleontologists, with their long view of man's evolution, may find ground for approving the type of selection here proposed, but they are not in a position to tell us how rapidly it could begin to increase the proportions of able people. We might hope to find the best answers

in analogies from the breeding of domestic animals, or from changes in gene frequencies in wild populations under the influence of changes in the environment. But animal breeders use methods incompatible with man's other needs, and this would invalidate the analogy. In the case of wild populations, the analogy might be fairly close if it were not for an important difference in the breeding habits of man compared to wild populations such as the fruit fly *Drosophila*. There is no evidence of selective breeding among fruit flies. They mate by chance, and geneticists call this system pan-mixia. But humans exercise considerable selection, and this selective or assortative mating tends to concentrate groups of genes in specific family lines. For a number of reasons which need not be considered here, there is probably a particularly high rate of assortative mating in the United States. In New England the able stocks have been intermarrying since their arrival in this country; among the newer immigrants, the abler individuals have moved rapidly up into the industrial-management and professional classes, while the less able individuals have found mates in other groups. Even more significant is the probability that within, as well as between, each of our social and economic classes there has been a continuous process of assortative mating with a considerable sorting out of able strains into specific family lines. By this process the proportionate distribution of favorable genes would be somewhat heavier among the smaller well-educated groups, compared with a somewhat thinner distribution among the larger less well-educated groups, but the greater aggregate of genes for ability would still be found in the larger though less well-educated group. These assumptions appear to get some confirmation from the studies made by psychologists on the distribution of capacity for intelligence among the various socio-economic classes in this country.[6] Such findings are important for they indicate that any process of selection, to be effective, must be all-inclusive, operating within every social-economic and educational group, and including the whole population.

To the extent that specific types of genes tend to concentrate in specific family lines within every social class, a system of selection which was only moderately effective might still make a considerable increase in the proportion of able people within one or two generations. Able people, like all other people, develop out of conditions in which heredity and environment are so intertwined that their "relative" effects cannot be sorted out. The people who have responded most successfully to their environment have by and large the best genetic capacity for responding and live in home environments best fitted to bring out such a response. Their children, therefore, have a double reason, both genetic and environmental, for achieving the ability to respond successfully to the environment. This reasoning is supported by the extensive studies of Terman[7] and many others in the field. There are thus strong grounds for the belief that any system of birth selection which improved genetic capacity would at the same time favor a bettter environment for the rearing of children. For this reason a return to the principle of selection for an environment should

[6] Anastasi, Anne, Differentiating Effect of Intelligence and Social Status, *Eugenics Quarterly*, Vol. 6, No. 2, June 1959, pp. 84-91.

[7] Terman, L. M., Genetic Studies of Genius. Vol. V, "The Gifted Child Grows Up," Stanford University Press, 1947.

be favored by "environmentalists" as well as by "hereditarians."

Such principles of selection do not carry connotations of "superiority" or "inferiority" except with respect to relative success or failure in specific environments. A man might fail in business when he might have made a great success as a musician, and so on through all the categories of different kinds of service to society. The success of a system of selection using the criteria of success or achievement in an environment, would depend a great deal on people finding the right niche for their particular capacities. In our society this is increasingly possible, and desirable for many reasons. The kind of proposals here suggested for establishing principles of selection conducive to the improvement of the genetic endowment of man are not of the sort to arouse opposition. Hereditarians, equalitarians and environmentalists can join hands in their support, along with all those who are interested in the future condition of society. No stage could be better set for their adoption.

Yet today the only important group of men engaged in the problems of man's genetic future are the medical geneticists with practical applications in the field of heredity counseling. This is an important field for it deals with genetic factors which natural selection should certainly tend to reduce. As present the field is necessarily limited to the simpler genetic manifestations such as genetic abnormalities; as knowledge increases it will move on to more complicated formulations and finally reach consideration of the extreme complexities involved in the factors which underlie the higher traits.

It would be a long time to wait for geneticists to unravel the genetic complexities of man's higher traits. And it is not necessary to do so. The assumptions on which we can base the development of eugenic proposals have far more scientific justification than those assumptions which, in other fields, we are using to determine actions of great importance. It is time that social scientists should be undertaking the serious study of the social, economic and psychological factors which affect parents of various kinds and in various environments in their decisions as to size of family. On the basis of such studies we can embark with confidence on a return to those principles of natural selection which accompanied the evolution from ape to man, from the society of animal bands to the complex societies of civilized man.

ECONOMIC IMPACT OF INSTRUCTION IN FAMILY PLANNING

A Proposal to the Japanese National Railways

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The object of the family-planning-movement is not only to regulate numbers of children but also to promote thereby the welfare and prosperity of the families induced to cooperate in the drive.

The Japanese National Railways (JNR) is pushing this movement forward, in order to improve the health and well-being of the families of its employees, which in turn will induce the employees to devote themselves wholeheartedly to the performance of their duties. This would mean that the work efficiency of the JNR staff will be raised and safe operation of trains, which is one of the main objectives of a railway carrier as a public utility, ensured.

It was in 1956 that the JNR joined this movement and set about giving its employees instruction in family planning. Since then about 65,000 families have thus been instructed.

The plan is to push forward this drive still further and see that all the families of the employees, numbering about 240,000 couples, receive such instruction.

Below is given an estimate of the results of family-planning instruction likely to be obtained in the event such instruction is carried out in the JNR in the future according to plan; an outline of the results thus far obtained is also given.

Needless to say, the instruction referred to has its impact on the recipients mentally as well as materially, but the statistical figures attached hereto are intended to indicate only the economic effect of such instruction. In other words, the figures are intended to represent the extent of the economic benefits that have been received, or are to be received, by the JNR management, the Mutual Aid Association of JNR Employees, and individual employees.

PROCEDURE FOR CALCULATION

During the two-year period from 1956 to 1958, 4,294 families were given individual instruction three times or more. Using the results obtained in this experiment calculations were made to find out how far the expenses of the management, association and employees were reduced owing to the decrease of the number of childbirths, cases of induced abortion, etc.

This will be followed by an estimate of the possible results of family-planning instruction to be applied to all families of married male employees of the JNR.

RESULTS

The reduction in the number of childbirths, cases of induced abortion and cases of miscarriage, as revealed in the survey made of 4,294 families that were

given necessary instruction and guidance three times or more during the period 1956-1958, is shown in Table 1.

How the figures given in Table 1 are reflected in the reduction of expense is shown in Table 2. It will be noted from Table 2 that the management of the JNR saved in one year 1,384,848 yen in terms of family allowance and the Mutual Aid Association, 2,451,406 yen in terms of delivery expense, nursing allowance, cost of induced abortion and cost involved in miscarriage, while the annual reduction in the pecuniary burden of the employees totaled 6,944,846 yen. In other words, the family-planning guidance as given to the 4,294 families has resulted in an annual saving of more than 10 million yen.

If it is to be assumed that the families of all JNR married employees from 26 to 45 years old are given the sort of guidance and instruction in family planning which has hitherto been given, then the number of childbirths, cases of induced abortion, etc., would be reduced as shown in Table 3 and an annual saving of 602,000,000 yen be effected, as is shown in Table 4.

It may be added that the figures given in the tables represent the results of one year. If and when guidance is to be given continually on a permanent basis, the results to be obtained would be incalculably effective.

Since all this means a definite alleviation of the monetary burden of the JNR employees, it may be safely averred that the family-planning movement should be pushed forward vigorously, as never before, if only for the promotion of the welfare of JNR employees.

(This survey was made on the basis of the data prepared by the Medical Section, Welfare Department, Japanese National Railways.)

TABLE 1

CHANGE IN NUMBER OF BIRTHS, ABORTIONS AND MISCARRIAGES BASED ON INSTRUCTION TO 4,294 FAMILIES

Number of families	Number of childbirths			Number of induced abortions			Number of miscarriages			
	Before instruction	After instruction	Decrease	Before instruction	After instruction	Decrease	Before instruction	After instruction	Decrease
4,294	634	398	236	391	237	154	103	49	54

TABLE 2

SAVINGS RESULTING FROM INSTRUCTION TO 4,294 FAMILIES

Beneficiaries of the family-planning movement		Family allowance	Delivery expense	Nursing allowance	Childbirth expense	Child-care expense	Cost of induced abortion	Cost involved in miscarriage	Total
					(All figures in yen)				
Management	Before instruction	3,720,312							3,720,312
	After instruction	2,335,464							2,335,464
	Amount saved	1,384,848							1,384,848
JNR Mutual Aid Association	Before instruction		4,749,294	1,521,600			226,780	53,045	6,550,719
	After instruction		2,981,418	955,200			137,460	25,235	4,099,313
	Amount saved		1,767,876	566,400			89,320	27,810	2,451,406
Employees	Before instruction				1,520,966	16,821,288	226,780	53,045	18,622,079
	After instruction				954,802	10,559,736	137,460	25,235	11,677,233
	Amount saved				566,164	6,261,552	89,320	27,810	6,944,846
Total		3,720,312	4,749,294	1,521,600	1,520,966	16,821,288	453,560	106,090	28,893,110
		2,335,464	2,981,418	955,200	954,802	10,559,736	274,920	50,470	18,112,010
		1,384,848	1,767,876	566,400	566,164	6,261,552	178,640	55,620	10,781,100

TABLE 3

ESTIMATED CHANGE IN NUMBER OF BIRTHS, ABORTIONS AND MISCARRIAGES FOR 240,000 FAMILIES

Number of families	Number of childbirths			Number of induced abortions			Number of miscarriages		
	Before instruction	After instruction	Decrease	Before instruction	After instruction	Decrease	Before instruction	After instruction	Decrease
240,000	35,424	22,224	13,200	21,840	13,248	8,592	5,736	2,736	3,000

TABLE 4

ESTIMATED SAVINGS RESULTING FROM INSTRUCTION TO 240,000 FAMILIES

Beneficiaries of the family-planning movement		Family allowance	Delivery expense	Nursing	Childbirth	Childcare	Cost of induced abortion	Cost involved in miscarriage	Total
					(All figures in yen)				
Management	Before instruction	207,868,032							207,868,032
	After instruction	130,410,432							130,410,432
	Amount saved	77,457,600							77,457,600
JNR Mutual Aid Association	Before instruction		265,361,184	85,017,600			12,667,200	2,954,040	366,000,024
	After instruction		166,479,984	53,337,600			7,683,840	1,409,040	228,910,464
	Amount saved		98,881,200	31,680,000			4,983,360	1,545,000	137,089,560
Employees	Before instruction				84,982,176	939,869,568	12,667,200	2,954,040	1,040,472,984
	After instruction				53,315,376	589,647,168	7,683,840	1,409,040	652,055,424
	Amount saved				31,666,800	350,222,400	4,983,360	1,545,000	388,417,560
Total	Before instruction	207,868,032	265,361,184	85,017,600	84,982,176	939,869,568	25,334,400	5,908,080	1,614,341,040
	After instruction	130,410,432	166,479,984	53,337,600	53,315,376	589,647,168	15,367,680	2,818,080	1,011,376,320
	Amount saved	77,457,600	98,881,200	31,680,000	31,666,800	350,222,400	9,966,720	3,090,000	602,964,720

The calculation was made on the following basis of expense (in Japanese yen) per childbirth:

Basis for Calculation

		In Yen
1. Management		
Family allowance	Monthly average per person	489
	Annual average per person	5,868
2. Mutual Aid Association of Employees		
(1) Delivery expense	Average per person	7,491
(2) Nursing allowance	Monthly allowance per person	400
	This allowance is given for six months. 400 x 6	2,400
(3) Cost of induced abortion	Cost per case—116 points x 10 x ½	580
(4) Cost involved in miscarriage or stillbirth	Cost per case 103 points x 10 x ½	515

3. Employees

	In Yen		
(1) Cost of childbirth—per person			
Cost of medical treatment	4,490		
Cost of childbirth	5,400		
Total	9,890		
Less amount paid by Aid Ass'n.	7,491		
Net cost			2,399
(2) Child-care expense—annual cost per person			
	In Yen		
Cost of child care	34,800		
Less nursing allowance	2,400		
Less family allowance	5,868		
Total	8,268		
Net cost			26,532
(3) Cost of induced abortion—cost per case 116 points x 10 x ½			580
(4) Cost involved in miscarriage—cost per case 103 points x 10 x ½			515

THE HUMAN SPECIES*

This special issue of the Scientific American contains nine pieces, each by an eminent authority; each is in itself a summary of recent thinking in the vast field which it covers. Together they present a vivid picture of the derivation of man and his culture. Even in a summary form, and reduced to those aspects which bear directly on man's evolution, it is a picture immensely stimulating for our thinking about man's future.†

Tools and Human Evolution

SHERWOOD L. WASHBURN

A series of recent discoveries has linked prehuman primates of half a million years ago with stone tools. . . . Now it appears that man-apes—creatures able to run but not yet walk on two legs, and with brains no larger than those of apes now living—had already learned to make and use tools. It follows that the structure of modern man must be the result of the change in the terms of natural selection that came with the tool-using way of life. . . .

The huge advantage that a stone tool gives to its user must be tried to be appreciated. . . . The utility of a mere pebble seems so limited to the user of modern tools that it is not easy to comprehend the vast difference that separates the tool-user from the ape which relies on hands and teeth alone. . . . It was the success of the simplest tools that started the whole trend of human evolution and led to the civilization of today. . . .

From the evolutionary point of view, behavior and structure form an interacting complex, with each change in one affecting the other. Man began when populations of apes, about a million years ago, started the bipedal, tool-using way of life. . . . Most of the obvious differences that distinguish man from apes came after the use of tools. . . . What evolved was the pattern of life of intelligent, exploratory, playful, vigorous primates; the evolving reality was a succession of social systems based upon the motor abilities, emotions and intelligence of their members. Selection produced new systems of child care, maturation and sex, just as it did alterations in the skull and teeth. Tools, hunting, fire, complex social life, speech, the human way, and the brain evolved together to produce ancient man of the genus *Homo* about half a million years ago. Then the brain evolved under the pressures of more complex social life until the species *Homo sapiens* appeared perhaps as recently as 50,000 years ago. . . .

Some of the early types of tools had lasted for hundreds of thousands of years and were essentially the same throughout vast areas of the African and Eurasion land masses. Now [with the advent of *Homo sapiens*] the tool forms multiplied and became regionally diversified. Man invented the bow, boats, clothing; conquered the Arctic; invaded the New World; domesticated plants and animals; discovered metals, writing and civilization. . . .

The long upper pelvis of the ape is characteristic of most mammals, and it is the highly specialized, short, wide bone in man that makes possible the human kind of bipedal locomotion. . . . The capacity for bipedal walking is primarily an adaptation for covering long distances. Even the aboreal chimpanzee can run faster than a man, and any monkey can easily outdistance him. A man, on the other hand, can walk for many miles, and this is essential for efficient hunting. According to skeletal evidence, fully developed walkers first appeared in the ancient men who inhabited the Old World from 500,000 years ago to the middle of the

*A Summary from the *Scientific American* of September, 1960.

†Reprints of the entire issue can be obtained from the editor of the *Scientific American*.

last glaciation. These men were competent hunters, as is shown by the bones of the large animals they killed. But they also used fire and made complicated tools according to clearly defined traditions. Along with the change in the structure of the pelvis, the brain had doubled in size since the time of the man-apes.

The fossil record thus substantiates the suggestion, first made by Charles Darwin, that tool use is both the cause and the effect of bipedal locomotion. Some very limited bipedalism left the hands sufficiently free from locomotor functions so that stones or sticks could be carried, played with and used. The advantage that these objects gave to their users led both to more bipedalism and to more efficient use of tools. . . . The success of the new way of life based on the use of tools changed the selection pressures on many parts of the body, notably the teeth, hands, and brain as well as the pelvis. But it must be remembered that selection was for the whole way of life. . . . The skull of the man-ape is that of an ape that has lost the structure for effective fighting with its teeth. Moreover the man-ape has transferred to its hands the functions of seizing and pulling, and this has been attended by reduction of its incisors. Small canines and incisors are biological symbols of a changed way of life; their primitive functions are replaced by hand and tool. . . .

One of the essential conditions for the organization of men in co-operative societies was the suppression of rage and of the uncontrolled drive to first place in the hierarchy of dominance. Recently it has been shown that domestic animals, chosen over the generations for willingness to adjust and for lack of rage, have relatively small adrenal glands. . . . The skull structure of the wild rat bears the same relation to that of the tame rat as does the skull of Neanderthal man to *Homo sapiens*. The same is true for the cat, dog, pig, horse and cow; in each case the wild form has the larger face and muscular ridges. In the later stages of human evolution, it appears the self-domestication of man has been exerting the same effects upon temperament, glands and skull that are seen in the domestic animals. . . . The brain seems to have evolved rapidly, doubling in size between man-ape and man. It then appears to have increased in size much more slowly; there is no substantial change in gross size during the last 100,000 years. . . . The indirect evidence strongly suggests that the first *Homo sapiens* was a much more intelligent creature [than Neanderthal man]. . . . The main point is that the kind of animal that can learn to adjust to complex, human, technical society is a very different creature from a tree-living ape, and the differences between the two are rooted in the evolutionary process. The reason that the human brain makes the human way of life possible is that it is the result of that way of life. Great masses of the tissue in the human brain are devoted to memory, planning, language and skills, because these are the abilities favored by the human way of life.

The emergence of man's large brain occasioned a profound change in the plan of human reproduction. . . . In all the apes and monkeys the baby clings to the mother; to be able to do so, the baby must be born with its central nervous system in an advanced state of development. But the brain of the fetus must be small enough so that birth may take place. In man the adaptation to bipedal locomotion decreased the size of the bony birth-canal at the same time that the exigencies of tool use selected for larger brains. This obstetrical dilemma was solved by the delivery of the fetus at a much earlier stage of development. But this was possible only because the mother, already bipedal and with hands free of locomotor necessities, could hold the helpless, immature infant. . . . The human type of mother-child relation must have evolved by the time of the large-brained, fully bipedal humans of the Middle Pleistocene. Bipedalism, tool use, and selection for large brains thus slowed human development and invoked far greater maternal responsibility. The slow-moving mother, carrying the baby, could not hunt, and the combination of the woman's obligation to care for slow-developing babies and the man's occupation of hunting imposed a fundamental pattern on the social organization of the human species.

. . . human society was heavily conditioned at the outset by still other significant aspects of man's sexual adaptation. In the monkeys and apes year-round sexual activity supplies the social bond that unite the primate horde. But sex in these species is still subject to physiological—especially glandu-

lar—controls. In man these controls are gone, and are replaced by a bewildering variety of social customs. In no other primate does a family exist that controls sexual activity by custom. that takes care of slow-growing young, and in which—as in the case of primitive human societies—the male and female provide different foods for the family members. . . .

Complex and technical society evolved from the sporadic tool-using of an ape, through the simple pebble tools of the man-ape, and the complex toolmaking traditions of ancient man to the hugely complicated culture of modern man. Each behavioral stage was both cause and effect of biological change in bones and brain. These concomitant changes can be seen in the scanty fossil record and can be inferred from the study of the living forms. . . . In ourselves we see a structure, physiology and behavior that is the result of the fact that some populations of apes started to use tools a million years ago. . . .

The Origin of Society

MARSHALL D. SAHLINS

. . . No living primate can be directly equated with man's actual simian ancestor, and no contemporary people is identical with our cultural ancestors. . . . On the primate side one must rely primarily on the few field reports of free-ranging groups and on certain pioneer studies of captive animals. . . . On the human side the nearest contemporary approximations to the original cultural conditions are [the known] societies of hunters and gatherers, preagricultural peoples exacting a meager livelihood from wild food resources . . . the Australian aborigines, the Bushmen of South Africa, the Andaman Islanders, the Shoshoni of the American Great Basin, the Eskimo, and Pigmy groups in Africa, Malaya and the Philippines. . . .

Confidence in the comparative procedure which equates modern hunters and gatherers with the actual protagonists of the Stone Age is fortified by the remarkable social congruence observed among these peoples, even though they are historically as separated from one another as the Stone Age is distant from modern times. . . .

Comparison of primate sociology with the findings of anthropological research immediately suggests a startling conclusion: The way people act, and probably have always acted, is not the expression of inherent human nature. There is a quantum difference, at points a complete opposition, between even the most rudimentary human society and the most advanced subhuman primate society. The discontinuity implies that the emergence of human society required some suppression, rather than a direct expression, of man's primate nature. Humon social life is culturally, not biologically, determined. . .

[The social behavior of the apes] is clearly the product of their nature, of animal needs and reactions, physiological processes and psychological reactions. Their social life, therefore, varies directly with the organic constitution of the individual and the horde. In an unchanging environment the social characteristics of a given subhuman primate species are unchanging, unless or until the species is organically transformed. The same cannot be said about human social arrangements. We are all one species, but our social orders grow and diversify, even within a constant environment, and they do so quite apart from minor biological (racial) differences that develop among different peoples. . . .

Yet the remarkable aspect of culture's usurpation of the evolutionary task from biology was that in so doing it was forced to oppose man's primate nature on many fronts and to subdue it. . . . primate urges often become not the secure foundation of human social life, but a source of weakness in it. . .

The powerful social magnet of sex was the major impetus to subhuman primate sociability. . . . Subhuman primates are prepared to mate at all seasons. . . . Among other mammals sexual activity, and likewise heterosexual society, is frequently confined to a comparatively brief breeding season. . . . Group existence confers advantages such as defense against predation. . . . [But] in the evolutionary perspective the intense long-term sexuality of the primate individual is the historic complement of the advantages of horde life. . . .

Sex is not an unmitigated social blessing for primates. Competition over partners, for example, can lead to vicious, even fatal, strife. It was this side of primate sexuality that forced early culture to curb and re-

press it. The emerging human primate, in a life-and-death economic struggle with nature, could not afford the luxury of a social struggle. Cooperation, not competition, was essential. Culture thus brought primate sexuality under control. More than that, sex was made subject to regulations, such as the incest tabu, which effectively enlisted it in the service of co-operative kin relations. Among subhuman primates sex had organized society . . . now society was to organize sex—in the interest of the economic adaptation of the group . . . in mankind . . . sex is controlled more by the intellect—the cerebral cortex—than by glands. Thus it becomes possible to regulate sex by morals; to subordinate it to higher collective ends. . . . In every human society sex is hedged by tabus; on time, place . . . on the sex and age of possible partners, on reference to sex in certain social contexts. . . . By way of an aside, it is notable that the repression of sex in favor of other ends is a battle which, while won for the species, is still joined in every individual to this day. . . . [Undoubtedly there has been some evolutionary trend toward a greater instinct for monogamy, especially among women, but it still has a long way to go.]

. . . kinship, with its economic aspect of co-operation, became the plan for primitive human society. . . . Many hunters and gatherers carry kinship to an extreme that is curious to us. By a device technically known as classificatory kinship they ignore genealogical differences between collateral and lineal kin at certain points, lumping them terminologically and in social behavior. Thus my father's brother may be "father" to me, and I act accordingly. Close kinship may be extended indefinitely by the same logic. . . .

The primate horde is practically a closed social group. Each horde has a territory, and local groups of most species defend their ground or trees against encroachment by others of their kind. . . . The band territory is never exclusive. Individuals and families may shift from group to group. . . . a great deal of interband hospitality and visiting is undertaken for purely social and ceremonial reasons . . . a general notion of tribalism, based on similarity in language and custom and on social collaboration, develops among neighboring groups. . . . It does not seem unwarranted to assert that the human capacity to extend kinship was a necessary social condition for the deployment of early man over the great expanses of the planet. . . . Warfare is limited among hunters and gatherers. Indeed, many are reported to find the idea of war incomprehensible. A massive military effort would be difficult to maintain for technical and logistic reasons. But war is even further inhibited by the spread of a social relation-kinship which in primitive society is often a synonym for "peace." . . . Bands lack true government and law; the rules of good order are synonymous with customs of proper behavior toward kinsmen. . . .

The primitive human family, unlike the subhuman primate mate group, is not based simply on sexual attraction. Sex is easily available in many band societies, both before and outside marriage, but this alone does not necessarily create or destroy the family. . . . Marriage and the family are institutions too important in primitive life to be built on the fragile, shifting foundations of "love." The family is the decisive economic institution of society. . . . Many anthropologists have testified that in the minds of the natives the ability to cook and sew or to hunt are much more important than is beauty in a prospective spouse. . . . Culture, reflecting the compulsions of economics, thus dramatically altered human mating and differentiated the human family from its nearest analogues.

"Peck orders" of dominance and subordination are characteristic of subhuman primate social relations. . . . Compared both to subhuman primate antecedents and to subsequent cultural developments, dominance is at its nadir among primitive hunters and gatherers. . . . The men who lead the band are the wiser and older. They are not, however, respected for their ability to commandeer limited supplies of desired goods. On the contrary, generosity is a necessary qualification for prestige; the man who does most for the band, who sacrifices most, will be the one most loved and heeded by the rest. . . . A second qualification for leadership is knowledge—knowledge of ritual, tradition, game movements, terrain and the other things that control social life. This is why older men are respected. In a stable society they know more than the others, and to be "old-fashioned" is a great virtue. The

headsman of a band can rule only by advice, not by fiat . . . the Shoshoni leader is "the Talker," and his Eskimo counterpart is "he who thinks. . . ."

The leveling of the social order that accompanied the development of culture is related to the fundamental economic change from the selfish—literally rugged—individualism of the primate to co-operative kin dealings. . . . Among primitives . . . food sharing follows automatically from the division of labor by sex . . . the family economy is a pooling of goods and services. . . . Mutual aid is extended far beyond the family. It is a demand of group survival that the successful hunter be prepared to share his spoils with the unsuccessful. . . . There was a time in human affairs when the only right of property that brought honor was that of giving it away. The economic behavior of primitives obviously does not conform to the stereotype of "economic man" by which we organize and analyze our own economy. . . . There is much to be learned about primitive economics here, and it would not be a mere exercise in analogy, for our kin life is the evolutionary survival of relations that once encompassed society itself.

In selective adaptation to the perils of the Stone Age, human society overcame or subordinated such primate propensities as selfishness, indiscriminate sexuality, dominance and brute competition. It substituted kinship and co-operation for conflict, placed solidarity over sex, morality over might. In its earliest days it accomplished the greatest reform in history, the overthrow of human primate nature, and thereby secured the evolutionary future of the species.

The Origin of Speech

Charles F. Hockett

. . . Nowhere in the world has there been discovered a language that can validly and meaningfully be called "primitive. . . ." The lowliest South African Bushman speaks in the forms of a rich symbolic system that is in essence perfectly comparable to the speech of the cultivated Frenchman. . . . Man is apparently almost unique in being able to talk about things that are remote in space or time (or both) from where the talking goes on. . . .

Human genes carry the capacity to acquire a language, and probably also a strong drive toward such acquisition, but the detailed conventions of any one language are transmitted extragenetically by learning and teaching. To what extent such "traditional transmission" plays a part in gibbon calls or for other mammalian systems of vocal signals is not known, though in some instances the uniformity of the sounds made by a species, wherever the species is found over the world, is so great that genetics must be responsible. . . .

The development [of human speech] must be visualized as occurring in the context of the evolution of the human horde into the primitive society of food-gatherers and hunters, an integral part, but a part, of the total evolution of behavior. . . . Children acquiring the language of their community pass through a stage that is closed in just the way gibbon calls are. A child may have a repertory of several dozen sentences, each of which, in adult terms, has an internal structure, and yet for the child each may be an indivisible whole. . . . The child takes the first crucial step, however, when he first says something that he has not learned from others. The only way in which the child can possibly do this is by blending two of the whole utterances that he already knows. . . .

These developments [in language] are also necessarily related to the appearance of large and convoluted brains, which are better storage units for the conventions of a complex communicative system and for other traditionally transmitted skills and practices. Hence the adaptive value of the behavior serves to select genetically for the change in structure. A lengthened period of childhood helplessness is also a longer period of plasticity for learning. There is therefore selection for prolonged childhood and, with it, later maturity and longer life. With more for the young to learn, and with male as well as female tasks to be taught, fathers become more domesticated. The increase of displacement promotes retention and foresight: a male can protect his mate and guard her jealousy from other males even when he does not at the moment hunger for her. . . .

Man's own remote ancestors, then, must have come to live in circumstances where a slightly more flexible system of communication, the incipient carrying and shaping of

tools, and a slight increase in the capacity for traditional transmission made just the difference between surviving—largely, be it noted, by the good old protohominoid way of life—and dying out. . . . Only after a very long period of such small adjustments to tiny changes of living conditions could the factors involved—incipient language, incipient tool-carrying and toolmaking, incipient culture—have started leading the way to a new pattern of life, of the kind called human.

The Distribution of Man

William W. Howells

Men with chins, relatively small brow ridges and small facial skeletons, and with high, flat-sided skulls, probably appeared on earth in the period between the last two continental glaciers, say from 150,000 to 50,000 years ago.

. . . our direct ancestor, like his older relatives, was at once product and master of the crude pebble tools that primitive human forms had learned to use hundreds of thousands of years earlier. His inheritance also included a social organization and some level of verbal communication.

Between these hazy beginnings and the agricultural revolution of about 10,000 years ago *Homo sapiens* radiated over most of the earth, and differentiated into clearly distinguishable races. The processes were intimately related. Like the forces that had created man, they reflected both the workings of man's environment and of his own invention. So much can be said with reasonable confidence. The details are another matter. The when, where and how of the origin of races puzzle us not much less than they puzzled Charles Darwin. . . .

Actually the most reasonable—I should say the only reasonable—pattern suggested by animal evolution in general is that of racial divergence within a stock already possessing distinctive features of *Homo sapiens* . . . such a stock had appeared at the latest by the beginning of the last glacial advance and almost certainly much earlier, perhaps by the end of the preceding glaciation, which is dated at some 150,000 years ago. . . .

The Upper Paleolithic invaders of Europe (*e.g.*, the Cro-Magnons) mark the definite entrance of *Homo sapiens*, and these men were already stamped with a "White" racial nature at about 35,000 B.C. But a recently discovered skull from Liukiang in China, probably of the same order of age, is definitely not Caucasian, whatever else it may be. And the earliest American fossil men, perhaps 20,000 years old, are recognizable as Indians. No other remains are certainly so old; we cannot now say anything about the first Negroes. Thus racial differences are definitely older than 35,000 years. And yet—this is sheer guess—the more successful *Homo sapiens* would probably have overcome the other human types, such as Neanderthal and Rhodesian men, much earlier if he had reached his full development long before. But these types survived well into the last 50,000 years. . . .

When we try to envisage the causes of racial development, we think today of four factors: natural selection, genetic drift, mutation and mixture (interbreeding). With regard to basic divergence at the level of races, the first two are undoubtedly the chief determinants. . . .

Both drift and selection should have stronger effects the smaller and more isolated the population. It is easy to imagine them in action among bands of ancient men, living close to nature. (It would be a great mistake, however, to imagine that selection is not also effective in modern populations.) Hence we can look upon racial beginnings as part accident, part design, design meaning any pattern of minor change obedient to natural selection. . . .

Man started as an apelike creature, certainly vegetarian, certainly connected with wooded zones, limited like all other primates to tropical or near-tropical regions. In becoming a walker he had begun to extend his range. Tools, social rules and intelligence all progressed together; he learned to form efficient groups, armed with weapons not provided by nature. He started to eat meat, and later to cook it; the more concentrated diet widened his possibilities for using his time; the hunting of animals beckoned him still farther in various directions.

All this was probably accomplished during the small-brained australopithecine stage. It put man on a new plane, with the potential to reach all parts of the earth, and not only those in which he could find food ready

to his hand, or be comfortable in his bare skin. He did not actually reach his limits until the end of the last glaciation, and in fact left large tracts empty for most of the period. By then he had become *Homo sapiens,* with a large brain. He had tools keen enough to give him clothes of animal skin. He had invented projectiles to widen the perimeter of his striking power: bolas, javelins with spear throwers, arrows with bows. He was using dogs to widen the perimeter of his senses in tracking. He had found what could be eaten from the sea and its shores. He could move only slowly, and was probably by no means adventurous. But hunting territory was precious, and the surplus of an expanding population had to stake out new preserves wherever there was freedom ahead. So this pressure, and man's command of nature, primitive though it still was, sent the hunters of the end of the Ice Age throughout the Old World, out into Australia, up into the far north, over the Bering Strait and down the whole length of the Americas to Tierra del Fuego. At the beginning of this dispersion we have brutes barely able to shape a stone tool; at the end, the wily, self-reliant Eskimo, with his complicated traps, weapons and sledges and his clever hunting tricks.

The great racial radiation carried out by migratory hunters culminated in the world as it was about 10,000 years ago. The Whites occupied Europe, northern and eastern Africa and the Near East, and extended far to the east in Central Asia toward the Pacific shore. Negroes occupied the Sahara, better watered then, and Pygmies the African equatorial forest; south, in the open country, were Bushman only. Other Pygmies, the Negritos, lived in the forests of much of India and southeastern Asia; while in the open country of these areas and in Australia were men like the present Australian aborigines, brown, beetle-browed and wavy-haired. Most of the Pacific was empty. People such as the American Indians stretched from China and Mongolia over Alaska to the Straits of Magellan; the more strongly Mongoloid peoples had not yet attained their domination of the Far East.

During the whole period the human population had depended on the supply of wild game for food, and the accent had been on the relative isolation of peoples and groups. Still close to nature (as we think of nature), man was in a good position for rapid small-scale evolution, both through natural selection and through the operation of chance in causing differences among widely separated tribes even if selection was not strong.

The Agricultural Revolution

Robert J. Braidwood

. . . About 250,000 years ago wide-wandering bands of ancient men began to make remarkably standardized stone hand-axes and flake tools which archeologists have found throughout a vast area of the African and western Eurasian continents, from London to Capetown to Madras. . . . By about 75,000 years ago the tools became sufficiently specialized to suggest that they corresponded to the conditions of food-getting in broad regional environments. . . .

Perhaps 50,000 years ago the modern physical type of man appeared. . . . By perhaps 30,000 years ago they spread to the New World. The successful adaptation of human communities to their different environments brought on still greater cultural complexity and differentiation. Finally, between 11,000 and 9,000 years ago some of these communities arrived at the threshold of food production. . . .

The first successful experiment in food production took place in southwestern Asia, on the hilly flanks of the "fertile crescent." (The fertile crescent is bounded on the west by the hills of Lebanon, on the north by the mountains separating Syria from Turkey; and in the east by the range between Iran and Iraq. It includes the headwaters of the Euphrates and the Tigris.) Here in a climate that provided generous winter and spring rainfall, the intensified food-collectors had been accumulating a rich lore of experience with wild wheat, barley and other food plants, as well as with wild dogs, goats, sheep, pigs, cattle and horses. It was here that man first began to control the production of his food.

There are still today a few relict groups of intensified food collectors—the Eskimos for example—and there were many more only a century or two ago.

The Human Population

Edward S. Deevey Jr.

[Over the ages], . . . as I calculate, 36 billion Paleolithic hunters and gatherers, including the first tool-using hominids, [came and went on this earth]. One begins to see why stone tools are among the commonest Pleistocene fossils. Another 30 billion may have walked the earth before the invention of agriculture. A cumulative total of about 110 billion individuals seem to have passed their days and left their bones, if not their marks, on this crowded planet. Neither for our understanding of culture, nor in terms of man's impact upon the land is it a negligible consideration that the patch of ground allotted to every person now alive may have been the lifetime habitat of 40 predecessors.

These calculations exaggerate the truth in a different way by condensing into single sums the enormous length of prehistoric time. To arrive at the total of 36 billion Paleolithic hunters and gatherers I have assumed mean standing populations of half a million for the Lower Paleolithic and two million for the Middle and Upper Paleolithic to 25,000 years ago. For Paleolithic times there are no archeological records worth considering in such calculations. . . . It is only because average generations of 25 years succeeded each other 39,000 times that the total looms so large. . . .

If number is the criterion, the human species is [now] making great progress. The population, now passing 2.7 billion, is doubling itself every 50 years or so. To some horrified observers the population increase has become a "population explosion." . . . Before accepting the implications of the population explosion it is well to set the present in the context of earlier human populations.

. . . the population curve has moved upward stepwise in response to the three major revolutions that have marked the evolution of culture. The tool-using and tool-making revolution that started the growth of the human stem from the primate line gave the food-gatherer and hunter access to the widest range of environments. Nowhere was the population large, but over the earth as a whole it reached the not insignificant total of five million, an average of .04 person per square kilometer, or .1 person per square mile of land. With the agricultural revolution the population moved up two orders of magnitude to a new plateau, multiplying 100 times in the short span of 8,000 years, to an average of one person per square kilometer. The increase over the last 300 years, a multiplication by five, plainly reflects the first repercussions of the scientific-industrial revolution. There are now 16.4 persons per square kilometer of the earth's land area. It is thus the release of restraint that the curve portrays at three epochal points in cultural history.

But the evolution of the population size also indicates the approach to equilibrium in the two inter-revolutionary periods of the past. At what level will the present surge of numbers reach equlibirum? That is again a question of restraint, whether it is to be imposed by the limitations of man's new command over his environment or by his command over his own nature. . . .

The Present Evolution of Man

Theodosius Dobzhansky

. . . It has . . . been argued that *Homo sapiens* has already emancipated himself from the operation of natural selection. At the other extreme are those who still assume that man is nothing but an animal. The second fallacy is the more pernicious, leading as it does to theories of biological racism and the justification of race and class prejudice which are bringing suffering to millions of people from South Africa to Arkansas. Assuming that man's genetic endowment can be ignored is the converse falsehood, perhaps less disastrous in its immediate effects, but more insidious in the long run. . . . For better or worse, biological evolution did not stop when culture appeared. . . .

The impact of human works on the environment is so strong that it has become very hard to make out the forces to which the human species is now adjusting. . . . [Natural selection] goes on, however, always within the context of environment. As that changes, the Darwinian fitness of various traits changes with it. Thus by his own efforts man is continually altering the selective pressure for or against certain genes.

The most obvious example, and one with disturbing overtones, is to be found in the

advance of medicine and public health. . . .

It was pointed out earlier that one effect of civilization is to increase mutation rates and hence the supply of harmful genes. A second effect is to decrease the rate of discrimination against such genes, and consequently the rate of their elimination from human populations by natural selection. In thus disturbing the former genetic equilibrium of inflow and outflow, is man not frustrating natural selection and polluting his genetic pool? The danger exists and cannot be ignored. But in the present state of knowledge the problem is tremendously complex. If our culture has an ideal, it is the sacredness of human life. A society that refused, on eugenic grounds, to cure children of retinoblastoma would, in our eyes, lose more by moral degradation than it gained genetically. Not so easy, however, is the question whether a person who knows he carries the gene for retinoblastoma, or a similarly deleterious gene, has the right to have children. . . .

In any case, although we cannot see all the consequences, we can be sure that ancient genetic patterns will continue to shift under the shelter of modern medicine. We would not wish it otherwise. It may well be, however, that the social cost of maintaining some genetic varieties will be so great that artificial selection against them is ethically, as well as economically, the most acceptable and wisest solution.

Selection in modern societies does not always encourage characteristics that we regard as desirable. . . . Much has been written about the differential fertility that in advanced human societies favors less intelligent over more intelligent people. . . . We cannot put our finger on the forces responsible for this presumed selection against intelligence. As a matter of fact, there is some evidence that matters are changing, in the U.S. at least. . . .

If this article has asked many more questions than it has answered, the purpose is to suggest that answers be sought with all possible speed. Natural selection is a very remarkable phenomenon. But it does not even guarantee the survival of a species. Most living forms have become extinct without the softening influence of civilization, simply by becoming too narrowly specialized. Natural selection is opportunistic; in shaping an organism to fit its surroundings it may leave the organism unable to cope with a change in its environment. In this light, man's explosive ability to change his environment may offer as much threat as promise. Technological evolution may have outstripped biological evolution.

Yet man is the only product of biological evolution who knows that he has evolved and is evolving further. He should be able to replace the blind forces of natural selection by conscious direction, based on his knowledge of nature and on his values. It is as certain that such direction will be needed as it is questionable whether man is ready to provide it. He is unready because his knowledge of his own nature and its evolution is insufficient; because a vast majority of people are unaware of the necessity of facing the problem; and because there is so wide a gap between the way people actually live and the values and ideals to which they pay lip service.

RECENT PUBLICATIONS

BEHAVIOR GENETICS: John L. Fuller and W. Robert Thompson. John Wiley & Sons, Inc., New York, 1960, 396 pp. (with references and index).

This book by a geneticist and a psychologist meets the very great need today for a comprehensive treatment of what the authors call "behavior genetics," the term they have chosen to describe what is sometimes called "psychological genetics" or "psychogenetics." It covers both animal and human material and should have a wide readership as behavior treated from a genetic point of view is one of the least explored and most significant areas for research today.

Chapters five through nine document the evidence for the inheritance of human behavior and form a valuable reference section. The chapter on experimental methods in behavior genetics provides very specialized accounts of the procedures used in psychological genetics and suggests others not yet widely tested. The authors state that their objective is not so much to provide a source for all possible procedures as to facilitate communication between psychologists and geneticists.

Fuller and Thompson arrive at some interesting conclusions from their study:

Sensory and perceptual processes are generally more alike in related individuals. Heritibility is not limited to anatomical defects such as deafness or chemical defects such as color blindness but is found less clearly in more complex perceptual processes.

The high frequency of success in demonstrating inheritance of behavioral variation indicates that heredity must be a common source of variation in nature.

Data gathered with human subjects point to heredity as an important determiner of intellectual level, though certainly not the only one. From the size of correlations alone, however, we can infer very little about the extent of its importance. But it is clear that the information on inheritance of intelligence in animal subjects agrees substantially with that obtained from human beings. In neither case has much progress been made with respect to the genic mechanism involved. Before this can be done, the authors suggest that a rather extensive reorientation may be necessary, possibly away from standard models of Mendelian genetics.

The work on psychological and physiological correlates of personality shows the part played by endocrines in determining strain differences. Since immediate effects of genes are biochemical, further research along these lines should help our understanding of the inheritance of personality.

Data support the view that hereditary influences upon behavior are not exceptional but are almost universal, but behavioral deviations are not evoked by particular genes as neatly as blood types or coat colors.

Possibly the most significant contribution of behavior genetics is its documentation of the fact that two individuals of superficially similar phenotypes may be quite different genotypically and respond in completely different fashion when treated alike, conclude the authors.

The last chapter on heredity and individual differences is divided into two sections, one concerned with population genetics and the other with pathways between genes and traits. Osborn's account of modern eugenics is described here as working toward a social organization for the formation of stable families and providing satisfactory niches for those incapable of this responsibility.

This type of eugenics is described as an approach to the "good society" which takes special account of man's inherent biological diversity and involves controlled natural rather than artificial selection.

Most of the book is sufficiently nontechnical for readers other than geneticists, and the extremely full listings of references will guide anybody in this difficult field.

PRINCIPLES OF HUMAN GENETICS: (Second Edition): Curt Stern. W. H. Freeman & Co., San Francisco, 1960, 753 pp., $9.50.

The publication of the second edition of this textbook on human genetics is a noteworthy event. It has been an invaluable text for reference and study in human genetics since its first appearance eleven years ago. But the past decade has witnessed breath-taking changes in human genetics, the author states. While the emphasis of the book remains on general principles, it has been extensively rewritten and includes very recent material such as the findings of Lejeune *et al.* on the 47th chromosome in mongols, hazards of radiation, and aspects of medical genetics. In spite of the technical nature of some of the chapters anyone seriously concerned with human genetics can read the book with understanding.

The chapter on selection in civilization is of particular interest for eugenists. Stress is laid on the tentative value —if not the often complete lack—of knowledge about the genetic basis of many differences among human beings. Stern uses the terms "preventive" and "progressive" eugenics to describe what has often been called "negative" and "positive" eugenics. He states that in a sense these two branches are identical since decrease of undesirable genic constitutions implies increase of desirable ones and vice versa. Even if "gene erosion" is not a serious problem at present, he concludes that a progressive eugenics program may some day—when we know more than we do now—be concerned with increasing the proportion of favorable genotypes instead of being satisfied with maintaining the current fraction of unfavorable ones.

Stern gives an account of certain progressive measures which have been suggested by eugenists. These include improvements in social and economic conditions which discourage genetically well-endowed parents from having more children. Subsidies in forms of larger salaries, greatly reduced taxes and special bonuses have been proposed, but Stern points out very fairly that it is seldom proposed that parents from specific groups be singled out for these premiums because individual injustices would certainly result. It is hoped rather that the measures would induce those persons who make genetically desirable parents to have more children and that the less desirable ones who already have a large number of children would not be induced to have still more.

Stern discusses a number of theoretical situations in which selection of varying strengths for or against various genotypes is postulated. Important applica-

tions to problems of human genetics follow from these considerations.

If the hopes and fears of the eugenics movement seem greatly exaggerated in light of a numerical treatment of the problems, the idealism which it concerns itself with the genetic fate of future generations has a sound core. Even a slight increase of desirable genotypes through progressive eugenic measures would be a social gain. With increasing knowledge genetic and eugenic counseling will become the foundation of man's direction of his own biological evolution. Although eugenic problems are not as immediately urgent as the pessimists believe them to be, their ultimate importance can hardly be overestimated, the author concludes.

PRINCIPLES OF GENETICS: Eldon J. Gardner. John Wiley & Sons, Inc., New York, 1960, 366 pp.

Written for college students in first courses in genetics this textbook emphasizes basic principles and tells the story of the classical experiments with plant, animal, and human material. Contributions from studies on microorganisms are included. The problem approach is used. The volume has illustrations on almost every page, including hand-drawn portraits of important geneticists.

MENTAL DISORDERS IN URBAN AREAS: An Ecological Study of Schizophrenia and Other Psychoses: Robert E. L. Faris and H. Warren Dunham. Hafner Publishing Co., New York, 1960.

This is a reprint, not a revision, of a book first issued in 1939. The authors have provided a new preface in which they state their preference for reprinting since revision would demand an entirely new book. As of 1959 the authors feel that their research suggests that abnormalities in the patterns of social experience, in which disorganization of the social system is a significant causal factor, also contribute to the mental ills of mankind.

This book, which was a pioneer study in the social aspects of mental disorder, is of interest in the light of subsequent research in the psychoses.

SCIENCE – The Endless Frontier – A Report to the President on a Program for Postwar Scientific Research: Vannevar Bush, National Science Foundation, Washington, D. C., July 1945 (reprinted July 1960), 220 pp.

Alan Waterman, Director of the National Science Foundation, attempts to assess the extent to which the objectives of this report, first printed in 1945, have been met. He feels that this remarkable document anticipated major needs and problems in postwar scientific research. Dr. Bush's report stressed basic research, the need for which is still vital especially within the government. Russia's Sputnik was the prize stimulator in this area. The report states that progress in heart disease, cancer, etc., may be made from fundamental studies in subjects unrelated to these areas. International exchange of scientific information was urged, and Dr. Waterman declares that the situation in regard to international conferences is probably more satisfactory now than any time since the report was first published. The report stressed the need for renewal of scientific talent. Quality rather than numbers have been stressed in the National Science Foundation's program here, but Dr. Waterman feels a number of years must elapse before the Federal-support programs can be fairly judged.

Dr. Waterman concludes that the government is doing well both in the provision of funds and the exercise of leadership but that people still do not understand the importance of education and science as distinguished from technology.

THIS CROWDED WORLD: Frederick Osborn. Public Affairs Pamphlet No. 306 (prepared in cooperation with the Population Council, Inc.) 25¢.

This pamphlet is an addition to the ever-increasing popular literature on expanding world population. Lucidly conceived and simply written, it treats of the decline in death rates and the necessity for a reduction in births. There are special sections on population problems in the United States and the low-income countries. Stages of family limitation are discussed.

The section on quality of population and the problem of genetic endowment deserves special consideration as quality is so widely ignored today. The author feels that out of advances in social science and human genetics should come practical applications for a sound distribution of births. He concludes that the future of our country may depend to a large degree on a better understanding of population changes in the world and on the solution of the problems created by these changes.

PEOPLE! Challenge to Survival: William Vogt. William Sloane Associates, New York, 1960, 257 pp., $4.50.

A unique feature of this "best-seller" type discussion of population problems is the anecdotal touch provided by illustrations from the author's travels in more than twenty-five countries and in forty-nine of our fifty states. These personal illustrations give the reader a feeling for the special atmosphere of each country that is usually not provided in discussions of population. The material on Scandinavia is particularly revealing.

Vogt is not a middle-of-the-roader. He concludes: Tranquilizers may quiet the insane, dissolve their dreams and fears. But these are not dreams. Time is running out. Almost one hundred more [people] every minute. . . .

HELEN G. HAMMONS

ON POPULATION: THREE ESSAYS. Thomas Malthus, Julian Huxley, and Frederick Osborn. Introduction by Frank W. Notestein. The New American Library of World Literature, Inc. (Mentor Books), New York, 1960, 144 pp., $0.50.

It is all very well to have inexpensive good reading on population questions made readily available, and one can only hope that a broad public will take advantage of this offering. The publisher, however, has made no contribution to clear thinking in referring (on the front cover) to "the birth rate which continues to rise in a world already crowded" or (on the back cover) by screaming, "AND THE BIRTH RATE IS RISING STEADILY!" The population problem is urgent enough even with a birth rate that in many countries merely refuses to drop. Understanding of the problem is weak enough that it can ill sustain the additional confusion contributed by a major item of misinformation.*

The three essays are Malthus' "A Summary View of the Principle of Population" (1830); Huxley's article, "World Population," from the March 1956 *Scientific American;* and the 1958 summary, *Population: An International Dilemma,* by Osborn of contributions and deliber-

ations of an "ad hoc committee" assembled by the Population Council. Huxley's vigorous statement provides welcome relief from the ponderosities of Malthus. But it is the longer first and third essays that comprise the meat of the volume—the first a dose of "Great Books" antiquarianism, the latter one of the better examples of the modern, semi-anonymous, bureaucratic "report."

For all the differences between the two, correctly emphasized in Notestein's introduction, there is a basic continuity, and not a wholly reassuring one, between the Malthus "summary view" and the Osborn "report." Both are concerned to diagnose a problem and to survey solutions. Neither, that is to say, is primarily a work of scientific inquiry aimed at isolating necessary and sufficient conditions of population change by inductive methods. Both — Malthus much more so, of course — are somewhat preoccupied with theological issues: the gloomy parson is comforted by the thought that an effective answer to the population dilemma, moral restraint, has a place in the plans of "a benevolent Creator," while Osborn finds that restraint of one kind or another is compatible with the ethics of the major religions. Nor are the two authors disagreed on Osborn's proposition, "The actual practice of family limitation is a highly individual matter," if for "family limitation" one reads "prudential restraint"; and Malthus' dictum that "direct legislation cannot do much" is echoed in Osborn's warning that "Governments should not be too hastily criticized for failure to act, or to succeed, in programs of family limitation." Malthus does, however, try to specify the characteristics of social structure, i.e., civil liberty and security of property, essential for the operation of the prudential restraint on population. Osborn is less daring, for he observes both that "strong motivation for limitation of family size can bring about significant declines in fertility without any radical transformation of traditional social structure" and that "it is fortunate that the underdeveloped countries are in a state of rapid revolutionary change." Malthus' failure as a prophet, spectacular though it was, perhaps reflected no more upon his science than does our present equivocation upon ours.

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*The cover pages of this book were not submitted to the author for approval. As soon as they were seen the publisher was advised on the mistakes, and these have been corrected in the second printing now on the presses. (Editor's note)

REPORT OF MEDICAL GENETICS COURSE AT BAR HARBOR

During the month of August, 1960 a course in Medical Genetics was given at Bar Harbor by the members of the faculty of the Johns Hopkins University School of Medicine and of the Roscoe B. Jackson Memorial Laboratory. The American Eugenics Society provided grants-in-aid to attend this course to 13 members of medical school faculties from the states of New York, New Jersey, Vermont and Connecticut.

The course, limited to 40 students, was conducted at Oakes Center. Classes were held from 8:30 A.M. to 12:30 P.M., and from 8:00 to 10:00 P.M. During the initial sessions, topics of basic interest in genetics, e.g. meiosis, mitosis, Mendelian heredity, population genetics, and histo-compatibility were discussed. Biochemical genetics, cytogenetics and statistical methods were discussed from various points of view. Cytogenetics, with its many recent advances, was particularly well handled and was of great interest to the medically oriented students.

During the afternoon or late evening the students had an opportunity to see selected films of the recent McGraw-Hill series on genetics. Many of these movies were exceptionally good. Since many of the students were concerned with teaching of genetics to medical students, the opportunity to see these films was most welcome. During the latter part of the course, there was a discussion of hereditary disorders of humans and of the frequently similar syndromes in animals, particularly in mice.

The course was well organized, and well presented. It offered a brief broad glimpse into many areas of genetics; such survey is of particular value to physicians whose interest in genetics is often confined to one particular aspect of the subject. While the limited time obviously dictated certain limitations in material, it seemed unfortunate that nucleic acids and bacterial genetics received little attention.

Obviously a successful course of this variety requires a great deal of labor, and the faculty from Hopkins and from the Jackson Laboratory are to be congratulated on their achievement. Such a course fulfills a real need in medical genetics at this time, and we hope that they will continue their fruitful educational collaboration.

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Periodical Reviews

GENETICS

A study of retinoblastoma in Ohio. M. M. Macklin. *Am. J. Human Genetics,* 12 (1960), pp. 1-43.

After surveying the Ohio population for cases of retinoblastoma, and conducting extensive pedigree studies, the author concludes that the responsible dominant gene can show almost complete penetrance in some families and low penetrance in others. This is attributed largely to the genetic background in which the gene operates. Pedigrees were presented showing examples where the gene was transmitted through many individuals without manifesting itself by the occurrence of the neoplasm. The accumulated data suggest that the average degree of penetrance may range between 20 and 34 percent.

Because of the characteristic of low penetrance, so-called sporadic cases in a family may not all represent examples of mutants or phenocopies. A thorough study of close and remote relatives often reveals the occurrence of other cases. Consequently, the author states that previously reported estimates of the mutation rates are too high since they have not adequately considered the penetrance phenomenon.

The author also discusses the difficulties encountered in giving accurate genetic counseling advice for this trait. It is apparent that if the penetrance of the gene is influenced by genetic background, the risk among the children of one heterozygote could be greatly different than that among the children of another heterozygote.

Y-chromosome inheritance of hairy ears. R. R. Gates. *Science,* 132 (1960), p. 145.

In his two-volume edition of "Human Genetics," published in 1946, the author presented an Italian pedigree of hairy ear rims. The distribution of cases in the pedigree is compatible with the hypothesis of holandric inheritance. In an evaluation of this pedigree, Stern (1957, *Am. J. Human Genetics,* 9:147-166) questioned its validity because of the nature of its original source. In fact, Stern concluded that no reliable evidence exists for holandric traits at the present time.

The author now claims to have further evidence showing that hairy ear rims is an holandric trait "beyond any doubt." He states that over 20 pedigrees were collected from jungle tribes in India showing inheritance from father to all sons, except in rare cases of lack of penetrance. The paper presenting these findings was only a preliminary report and no pedigrees were presented. This forces the reader to withhold judgment until the pedigrees are available for analysis.

Genetic control of isoniazid metabolism in man. D. A. Price Evans, K. A. Manley, and V. A. McKusick. *Brit. Med. J.,* 5197 (1960), pp. 485-491.

Isoniazid is a compound which is effective in the treatment of human tuberculosis. The authors have presented the results of the largest study to date, which further support the hypothesis that the metabolism of the drug is under genetic control.

Fifty-three families were studied. The members were given the drug orally and six hours later the plasma concentration was determined by chemical means. Individuals were classified as slow inactivators and rapid inactivators. By gene frequency methods the distribution of slow and rapid inactivators among the children of rapid x rapid, rapid x slow, and slow x slow marriages was shown to be compatible with the hypothesis that slow inactivation is a simple recessive trait.

An evaluation of the treatment of phenylketonuria with diets low in phenylalanine. W. E. Knox. *Pediatrics,* 26 (1960), pp. 1-11.

In a much needed review paper, the author summarized the literature up to December, 1959, and evaluates the results of treatment of phenylketonurics with diets low in phenylalanine. The criteria for improvement were based on psychometric performance, IQ score, absence or reduction in frequency of seizures, and normal electroencephalograms.

Phenylketonuria results from the inactivity or absence of the enzyme needed for the conversion of phenylalanine to tyrosine. The accumulation of phenylalanine leads to the disorder. It has been well established that phenylketonuria is a recessive trait. As soon as it was realized that a diet low in phenylalanine might correct the disorder, patients in many parts of the world were placed on such a diet.

The follow-up of these patients stresses the value of early treatment. No significant change occurred in the psychometric performance of 44 patients over 3 years of age treated for 1 year, although temporary improvements did occur in regard to restlessness, irritability, attentiveness, and frequency of seizures. Comparing a group of 43 patients treated before 3 years with an untreated group shows impressive differences. The treated group showed 18 times as many with an IQ over 60 and twice as many with normal electroencephalograms. Seizures were also less common in this treated group. Subdividing the treated group into treated before 16 months and treated after 16 months also showed the importance of starting the treatment as soon after birth as possible. The early treated group had four times as many with an IQ over 60, more normal electroencephalograms and none with seizures.

The pressing question is how long does treatment have to be continued? It has been hypothesized that brain damage occurs during the early months following birth. If so, perhaps if treatment is started soon after birth and continued for a year or two, development will be normal. However, this is still an unanswerable question. Only two patients have been started on the treatment before 16 months, kept on it for at least 10 months, and observed longer than 9 months after treatment was stopped. At the last observation, their IQ values were 83 and 97. However, generalizations are not possible since two cases do not constitute a large enough sample. Twenty cases have been reported in the literature where the IQ ranged from 62 to 103 in the absence of any treatment. Perhaps the two treated cases would have achieved their degree of development irrespective of treatment. Only time and a large series of cases will answer the important question.

Nuclear sex determination in azoospermic adults and in newborns with hypospadias. I. Halbrecht. *Fertiltiy and Sterility,* 11 (1960), pp. 112-117.

The frequency of true sex-reversal in man is unknown, but the author contends that it is much higher, particularly female to male sex-reversal, than hitherto believed. He gives as main evidence the results of a study carried out on 30 husbands showing azoospermia. Six of the thirty husbands were chromatin positive, which is a characteristic of normal females.

Although no cytological studies were made, the author implies that these individuals possess two X chromosomes and, therefore, are sex-reversed females. However, the author states correctly that there is no positive evidence at present that a chromatin positive pattern is always associated with the presence of two X chromosomes, and therefore, he says that his conclusions of sex-reversal may not be justified.

As an alternative interpretation of his results, it may be argued that the high frequency of chromatin positive azoospermic individuals observed by the author is not due to the phenomenon of sex-reversal, but due to non-disjunction which leads to the formation of XXY zygotes. The extent of variability among XXY individuals is not known, but if the range of expression can extend from extreme intersexes (as shown by some Klinefelters) to near normality, then this could explain the occurrence of chromatin positive azoospermic individuals who are outwardly phenotypically normal. Future cytological studies will undoubtedly bring out the real answer to this problem.

Chromosomal translocations in Mongolism and in normal relatives. L. S. Penrose, J. R. Ellis, J. D. A. Delhanty. *Lancet* 7147 (1960), pp. 409-410.

The results of experimental studies with translocations in plants and animals predict that mongolism in man might result from a mechanism other than trisomy for chromosome 21. The authors have verified this prediction by reporting the occurrence of three mongols with translocations involving the 21st chromosome. Two of the mongols are siblings. Each of the three has 46 chromosomes.

A cytological examination of the mother, grandmother, and sister of the two affected siblings showed the presence of only 45 chromosomes. From this cytological picture, the authors conclude that a reciprocal translocation occurred in an ancestor on the female side. Most of chromosome 21 became attached to chromosome 15. The centric fragment was then lost and the fuzed chromosome was transmitted through several generations to normal individuals. These normal individuals with 45 chromosomes produce balanced and unbalanced gametes. The unbalanced gametes contain the large fuzed chromosome and a normal chromosome 21. The union of an unbalanced gamete with a normal gamete results in a zygote which contains the genetic material of chromosome 21 in an almost three-fold condition. The two siblings are of this type.

This unique situation is of interest in genetic counseling because a detailed cytological examination of the normal relatives of such types of mongols should yield information as to the potential producers of mongol children. The chance of locating 46 chromosome mongols with a translocation would be increased by studying families with multiple cases, or by studying mongols born to young mothers.

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POPULATION

Pilot study on social mobility and its association with fertility in West Bengal in 1956. S. Janardan Poti and Subodh Datta. *Artha Vijnana* 2, 2 (June, 1960), pp. 85-95.

Little is known about the relationship between social mobility and fertility outside of a few Western countries. Yet such mobility is often assigned the key role in demographic transitions. Poti and Datta report some of the results of a pilot investigation undertaken by the Indian Statistical Institute, Calcutta. Their study was designed to evolve concepts for use in a future, more comprehensive, investigation, and to test methods for collecting data. Nevertheless, some interesting "tendencies" were uncovered in the population studied.

The sample consisted of twenty-four villages selected at random from eight rural districts in West Bengal plus twenty census blocks selected at random from the city of Calcutta. A total of 600 rural households and 500 city households were included. Data on various demographic characteristics were collected for every member of these households, together with the occupational history of each member returned as an "earner." For earners who were ever married males, detailed fertility histories were obtained, including wife's age at marriage, her age at successive live births, her age at the time of inquiry (or at death), and the number of living children. Considerable information on the household economy was also gathered.

Inter-generational mobility was measured by comparing father's occupation at the time of the survey, or at retirement or death, with son's present occupation, or occupation at retirement or death. Only eldest living sons and their married brothers (living or dead) were included in the comparisons. Thus a small proportion of the population with no sons surviving at the time of the survey is excluded.

Five occupational categories were used for the rural sample; four in the urban. Extensive overlapping of income ranges is apparent among the rural occupational categories, leading the authors to doubt that the direction of rural social mobility can be determined. Unfortunately, no measure of dispersion other than the range for each category is provided, making it impossible for the reader to assess the appositeness of this conclusion.

The major substantive findings include the following: (1) In terms of the authors' categories, occupational mobility is more common in the rural sample than in the urban one. Nearly a quarter of the rural working population moved out of the father's occupational group into another rural occupational category, while such mobility among the urban-born population is rare. (2) Those males who remained in their fathers' occupational categories (whether rural or urban) generally had higher fertility, and often lower infant mortality, than those who were mobile. (3) Agricultural laborers are found to have strikingly lower fertility than other rural occupational categories, while urban manual laborers have higher fertility than urban lower professionals and those engaged in urban services and urban retail trade (all one category). (4) Although it is not pointed out by the authors, if their rural categories are arranged in order of mean family income, a consistent positive association with fertility is apparent. (5) Males *moving into* the category of urban laborer from rural

areas show strikingly lower fertility than both (a) males *born into* the urban laborer category, and (b) rural males remaining in their category of origin. The fertility behavior of males moving into the urban category of lower professionals, services, and retail trade shows more variability. The fertility of these males may be higher or lower than that of males entering this category by birth, depending on the rural occupational category of origin.

Some of these tentative findings are of such importance that the impending full-scale study is to be awaited with considerable anticipation. The reader may wish to compare Poti and Datta's material with Driver's paper on "Fertility Differentials Among Economic Strata in Central India" in the June, 1960, issue of *Eugenics Quarterly*.

Clinical effectiveness of contraceptive methods: Results of a Delhi study. S. N. Agarwala. *The Journal of Family Welfare* (India) 6, 3 (March, 1960), pp. 1-20.

In 1940 Stix and Notestein published what has become a classic study of New York birth control clinic effectiveness. Agarwala has carried out a more modest but nonetheless substantial study in Delhi which is in many ways comparable. The basic data consisted of case cards and follow-up visit cards relating to 5912 patients who visited family planning clinics belonging to the Contributory Health Service Scheme of the Government of India.

The patients visiting the clinics consisted mostly of women of moderate income, 89% literate, with a high mean age at marriage (for India) of about 17.0 years, and a mean age at first maternity of 19.2 years. The mean interval between *consummation* of marriage and first maternity was 25.7 months. The average interval between consummation of marriage and first enrollment at a clinic was 9.6 years, by which time the women had had an average of 3.6 live births and — counting stillbirths and abortions — slightly over 4 pregnancies. The pregnancy rate before clinic enrollment was 63 per 100 years of exposure.

Significantly, over half of the women (58%) had practiced one or more methods of contraception before clinic attendance. The condom was by far the most common pre-clinic method, followed by withdrawal and by diaphragm and jelly. Two-thirds of those attempting family limitation had begun their efforts at some time prior to a fourth pregnancy. Agarwala estimates that pre-clinic contraceptive efforts succeeded in reducing pregnancies by nearly 43%.

Of those women visiting a clinic, 40% were subsequently "lost," i.e., no prescription was made either simply because there was no contact after the first visit or because the patient had moved or her house could not be located. Of those who *were* prescribed contraceptives, only about half "continued to use them actively." Regardless of the extent of subsequent use—if any—of the clinic prescription, the overall pregnancy rate for women with whom the clinics succeeded in maintaining some contact was about 13 per 100 years of exposure. Comparing this with the pre-clinic contraceptive-use pregnancy rate of 35, the author concludes that a reduction of nearly 63% was obtained following clinic attendance, or a total reduction of about 78% in the pregnancies which might have been expected to occur with no contraception whatever. "It is clear . . . that post-clinic attempts at reducing pregnancies were more successful than pre-clinic attempts," the author states.

"It can therefore be said that through the use of clinic service, the patients were further successful in reducing pregnancies." (P. 19)

Agarwala notes that the unavailability of post-clinic data for 40% of the total population exaggerates the success of the clinic service. Throughout his paper it is often unclear which subpopulations are being compared. Since 53% of those who were "lost" had pre-clinic contraceptive experience (p. 13), it appears that the pre-clinic and post-clinic contraceptive-use pregnancy rates are based on different, but overlapping, populations. Figures given (pp. 11 and 18) seem to support the reviewer's inference. Thus the pre-clinic pregnancy rate for all contraceptors is being compared with the post-clinic pregnancy rate for those remaining in touch with the clinics. It is to be regretted that the author has not provided comparative figures for a homogeneous group for which both pre-clinic and post-clinic data are available.

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[SEAL] ETHEL J. MCFADDEN
(My commission expires May 1, 1961)

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